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CIVIL ENGINEERING.

Some account of Leveling Instruments, with a description of one of an improved form. *By* THOMAS STEVENSON, C. E., Edinburgh.*

The improved spirit level about to be described, was made for me in 1840, by Mr. Adie, and afterwards described in a letter to the Institution of Civil Engineers.†

Since then I have had two levels, of the common construction, altered to the new form. On a late occasion, these instruments were exhibited to the Royal Scottish Society of Arts; and, as no drawings had been laid before the public, that Society requested me to prepare a description with diagrams, that these might be published in their Transactions. In accordance with their request, therefore, I have drawn up the present description; and have also consulted many early writers, to ascertain, as well as I could, the history of one of the most important of geodetical and engineering instruments.

There unfortunately exists a great deal of conflicting evidence regarding the true inventors of the different parts of the spirit-level. Indeed, there are hardly two authorities who agree upon the subject.

The great Huygens appears to have been the first to *apply the telescope to a level* of his, which was constructed on the principle of the plummet. This is noticed in the life prefixed to his works,‡ in

* Exhibited and verbally described to the Royal Scottish Society of Arts, on the 22d January, 1844; and this written description requested.

† Engineer and Architect's Journal, vol. v.

‡ Christ. Hugenii Op. Var. Lugd. Batav. 1724.

the following terms:—"Ibi" (Lutetiæ) "vixit ab anno 1666 ad annum 1681. Durante hoc tempore pulcherrima subtilissimaque multa in mathematicis detexit variaque ex iis operibus conscripsit quæ nunc in unum corpus collecta quid in variis Matheseos partibus præstiterit sub oculis ponunt. Præter ipsius jam memorata inventa præclara inter alia duo insigni usu eminent. *Libellam telescopio munitam* ita construxit ut ipsi præ ceteris fides haberi possit," &c.

The honor of having first applied the *air-bubble* to the determination of horizontality, seems to be due to that universal genius Dr. Hooke. From all that I can gather, it appears that his invention must have been made subsequent to 25th March, 1674, and prior to the year 1675, as, in his "Attempt to prove the Motion of the Earth by Observations," of date 25th March, 1674, he describes a new method of *stilling the plummet*, by immersion in water. While in his animadversions,* published also in 1674, after fully describing his invention of the air-bubble confined in a tube, he speaks of its peculiar advantages, and great delicacy of movement, and remarks,—"This can hardly be performed by the ordinary way of plummets, without hanging from a vast height, which is not practically to be performed without almost infinite trouble, expense, and difficulty," &c.

Hutton, in his Mathematical Dictionary, remarks, that the application of the air-bubble to the level, "is said to be due to M. Thevenot," but with what justice I cannot say, having been unable to meet with any reference to this instrument in the writings of that author. Thevenot was born in 1621, and he died in 1692.

I have been unable to discover who was the inventor of the *circular level*, which, I imagined, had been of recent date; but Switzer, at page 91, of his Treatise on Water-Works, which was published in 1734, remarks, that the circular level was then employed in the construction of the surveying instrument called a plane-table.

According to Sir John Herschel, *the cross-hair*, which gives so much accuracy to all astronomical, as well as leveling, instruments, was the invention of Gascoigne, a young Englishman, who used it in 1640. He was killed, at the age of 23, at the battle of Marston Moor.

M. Le Bion† appears to have been the first to *conjoin the telescope of Huygens with the air-bubble* of Dr. Hooke; and this must have been subsequent to the year 1684, as such an instrument is not shown in De la Hire's edition of Picard's Treatise on Leveling.‡

But it was not till Sisson's improvements that the level could be considered as in any way an accurate, or philosophic, instrument.

* Animadversions on the first part of the Machina cælestis of the Hon., learned, and deservedly famous Astron. Johannes Hevelius, Consul of Dantzick, together with an explication of some instruments made by Rob. Hooke, Prof. Geom. in Gresh. Coll., and F.R.S. Lond. 1674, p. 61, *et seq.*

† Traité de la Construction et des Principaux usages des Instrumens de Mathematique. Par N. Le Bion, Ingenieur du Roi pour les Instrumens de Math. Nouv. Edit. a la Haye, 1723.

‡ Traité du Nivellement Par M. Picard, mis en lumière par les soins de M. De la Hire. 12mo. A Paris, 1684.

All that were made previous to this time were coarse instruments, adjusted by a ball and socket, and, in other respects, resembling the common perambulatory survey-level, which, from the nature of the construction, can be leveled in only one direction, and cannot be reversed, or moved, even in the slightest degree, without requiring re-adjustment. Sisson may, therefore, be considered as the inventor of the instrument in common use. The main feature in his improvements was the introduction of the four screws called the *parallel plate screws*, (D, in the diagram.) I have been unable to find out the date of Sisson's improvement; and, indeed, the only notice I can find of him is the following in Switzer's System of Water-Works:—"The invention," alluding to the instrument with parallel plate-screws, "as I take it, (for I am not as yet well acquainted with that gentleman,) of William Sisson, at the corner of Beaufort Buildings, in the Strand."*

Since the time of Sisson, the celebrated Ramsden introduced a tangent screw and clamp, for moving the instrument with accuracy through small distances in an arimuthal direction. Messrs. Troughton and Simms also made several improvements in the arrangement of the various parts of the instrument; and Mr. Gravatt, has, of late years, added a cross-bubble for facilitating the *rough-setting* of the instrument—or that adjustment which is made with the legs of the tripod; and an enlargement of the diameter of the object-glass, so as, by the admission of a greater number of rays of light, to allow of the telescope being shortened, without impairing its optical powers.

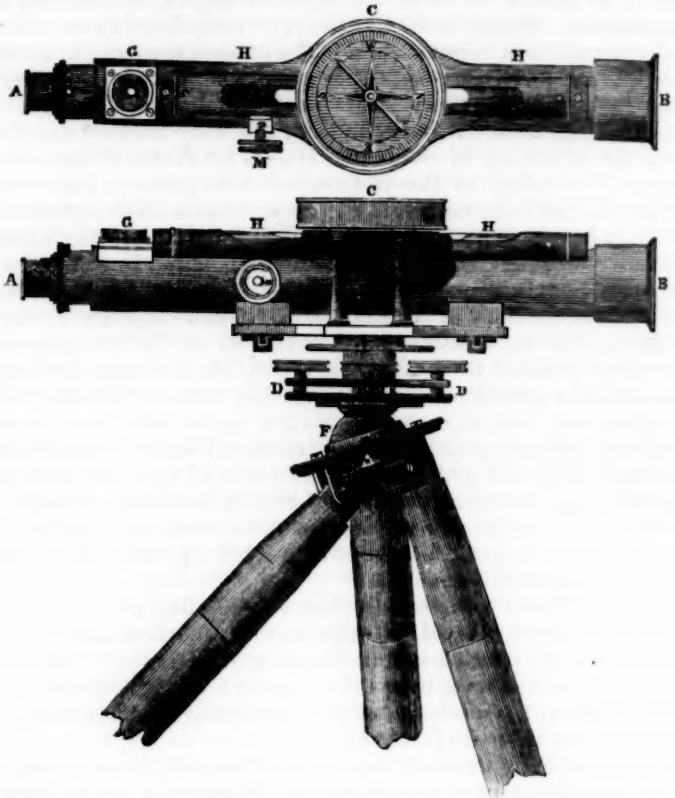
Having thus endeavored to describe the successive changes which the level has undergone, I shall now proceed to notice the nature of the present improvements.

The first of these is the substitution of a circular, or, to speak more correctly, a *spherical* level, G, sluggish in its motions, instead of the small cross-level, which was introduced by Mr. Gravatt. The advantage of the circular level over the common form, is its peculiarity in at once showing the deviation of the instrument from horizontality in both directions, instead of only one.

Before describing the next improvement, it may be proper to state, that the clumsiness of the common level consists in its being at all dependent on the setting of the legs. This arises from the circumstance of the ball and socket motion, K, being controlled in its action by the parallel plate screws of Sisson, D, the consequence of which is, that, in using the common level, care must be taken to set the instrument very nearly level *by the eye*, so as to be within the range of the parallel plate screws, D, otherwise it is impossible to adjust the instrument. And, although to the practical man, the trouble attending this may be comparatively small, still he will admit that it is one of the most irksome parts of the whole operation of leveling; to say nothing of the time that is lost in adjusting the instrument afterwards, with the parallel plate screws. What appeared to be wanting was a motion for the preliminary, or *rough-setting*, intermediate in nicety between those of the parallel plate screws, and of the legs. In order

* An Universal System of Water and Water-Works; by Stephen Switzer, 2 vols. 4to. Lond. 1734.

to gain this end, a ball and socket motion, F, having a clamp, N, is introduced in addition to the ball and socket, K, whose action is limited by Sisson's parallel plate screws, D, *so that my improved level has two ball and socket movements.*



A B, is the telescope; C C, the compass box; M, the screw for adjusting the focus; H H, the tubular spirit-level; G, the spherical, or circular, level; D D D, the parallel plate screws of Sisson; K, the old ball and socket motion; F, the new ball and socket motion; N, clamping screw for socket motion.

With the instrument thus improved, the observer is made quite independent of the level of the ground where he sets the legs of his instrument, and may place them without regard to the inclination of the telescope to the horizon. Looking first to the circular level, G, and releasing the clamp, N, of the ball and socket, F, he, with one hand, moves the head of the instrument till the bubble is in the centre of the circle, an operation which is done almost instantaneously.*

* In the annexed plan the instrument is shown off the level, so that neither the air-bubble of the circular level, G, is in the centre of the circle; nor does the air-bubble in the tube, H H, correspond with the file-marks made on the glass.

The socket screw, N, is then clamped, and the telescope bubble H H, is brought to the *absolute* level by a slight touch of the parallel plate screws, D. In this way the legs of the tripod never need to be moved after the instrument has been placed on the ground, and the parallel plate screws have almost nothing to do—advantages which all who are accustomed to leveling will fully appreciate.

In leveling over mountainous districts, it very often happens that it is desirable to select a station where the ground is so rugged and precipitous as to render it difficult, if not impossible, to find three points for the extremities of the legs of the instrument to rest on, which shall be on such levels as to bring the telescope within the range of the parallel plate screws; *but wherever the instrument can be made to stand with safety, the bubble of the improved level can be adjusted, and adjusted in exactly the same time, and with exactly the same ease, as if the instrument were placed on level ground.*

Another advantage of these improvements is the removal of a great practical difficulty which is often experienced on sloping ground. The instrument being set and properly adjusted, the observer, on looking through the telescope, may discover that he is not within the range of the leveling staff; in other words, he has chosen a station too high, or too low, to admit of his seeing any part of the staff within the field of the object-glass. The only remedy for this is to choose a new station where the instrument must be again set up and levelled, at a great expense of time and trouble. In order to remedy this, it was my intention at one time to have fixed on the telescope a French level, on the principle of the plummet, in order speedily to discover, before making the adjustments, whether the intended station were within the range of the staff, or not. But the instrument can be roughly set with so much quickness, by means of the additional ball and socket, that the French plummet may be considered as being now scarcely necessary.

In my letter to the Secretary of the Institution of Civil Engineers, I pointed out the advantages which would result to the surveyor, were the theodolite provided with a second ball and socket motion; but no opportunity of trying this has as yet occurred.

Edinburgh New Philos. Journ.

Mineral and Metallic Statistics.

By the returns to five several orders made by the House of Commons, which were obtained by the exertions and perseverence of Sir J. J. Guest, Sir C. Lemon, and Mr. Evans, (M. P. for North Derbyshire,) we are enabled to lay before our readers a most correct account of the various exports and imports of iron and iron ore, hardware, cutlery, &c., copper ore, copper, tin, zinc, lead ore, and lead, for the year ending January 5, 1844.

Commencing with iron, it appears there was imported in the year, iron ore 131 tons, chromate of iron 1393 tons, pig-iron 243 tons, un-

wrought iron in bars 12,795 tons, bloom 563 tons, rod-iron 12 tons, old, broken, and cast-iron 286 tons, cast-iron only 8 tons, steel unwrought 1697 tons—of these, 97 tons only were entered by weight, the remainder by value, 11,035*l.* 6*d.* 9*d.* Of the several countries from which these importations came, the principal is Sweden, whence we have received of iron 10,909 tons, and steel 1558 tons, leaving but a small portion to divide between twenty other places. Our exports of foreign iron have been, unwrought in bars 3986 tons, rod 10 tons, hoops 2 tons, cast-iron 11 cwt., steel, unwrought, 1456 tons. The total quantity of foreign iron retained for home consumption was 14,782 tons, upon which the net amount of duty was 14,563*l.* The exportation of that staple produce of our own country, British iron, was as follows:—bar-iron 176,148 tons, bolt and rod 22,625 tons, pig-iron 154,770 tons, cast-iron 16,449 tons, iron wire 1508 tons, wrought-iron, consisting of anchors, grapnels, &c., 3058 tons, hoops 14,591 tons, nails 6020 tons, and all other sorts, except ordnance, 44,577 tons, old iron for manufacture 5924 tons, and unwrought steel 3199 tons. Those places which have taken the greatest portions of this produce are Russia 10,963 tons of bar-iron; Denmark 10,447 tons bar, and 7010 tons pig; Prussia 12,009 tons bar, 17,480 tons pig; Germany 13,298 tons bar, 6322 tons pig, 1339 tons cast; Holland 17,509 tons bar, 75,953 tons pig, 4317 tons cast; Belgium 4279 tons cast; France 4237 tons bar, 22,103 tons pig; Italy 21,930 tons bar, 3982 tons bolt and rod, 3005 tons pig; Turkey and Continental Greece 6412 tons bar; East Indies and Ceylon, 20,620 tons bar, 2967 tons bolt; British North American Colonies 6837 tons bar, 1995 tons cast; foreign West Indies 5043 tons bar, 1646 tons cast; and to the United States 21,336 tons bar, and 7148 tons pig. The largest quantity of unwrought steel has been to the latter place, viz., 1336 tons.

Of British hardware and cutlery, we exported, in the year, 17,183 tons, valued at 1,745,518*l.*; the principal of which has been, to Germany 1237 tons, value 159,889*l.*; East Indies 1402 tons, value 142,607*l.*; British North American Colonies 1129 tons, value 102,260*l.*; British West Indies 997 tons, value 80,040*l.*; foreign West Indies 657 tons, value 48,609*l.*; United States 4282 tons, value 448,341*l.*; Brazil 943 tons, value 80,070*l.*; and divers other places, varying from 100 to 500 tons.

We now come to copper. Of foreign copper ores we have imported 55,720 tons; and of metallic copper, unwrought and wrought plates, and coins 805 tons. Of the ores, the greatest quantities have come from Cuba and Chili; from the former 31,683 tons, and the latter 19,829 tons; 54,370 tons of this ore has been retained for home consumption, the net amount of duty received thereon being 64,445*l.* 3*s.* 5*d.* The total of British copper exported, from twenty-three ports, was 17,515 tons, of which London sent 6469 tons, Swansea 4502 tons, and Liverpool 5587 tons; France took 4891 tons, the East Indies 6125 tons, and the United States 1473 tons. The total quantity of foreign copper exported was 672 tons. Of the above 17,515 tons of British copper, 8163 tons were unwrought, in bricks and pigs; 60 tons of coin; sheets, nails, &c., 8386 tons; wire 6 tons; and other sorts

of wrought-copper 597 tons. Previous to the 9th of July, 1842, the whole of the copper smelted in the United Kingdom from foreign ore was but 262 tons. Of foreign copper ore, containing not more than 15 per cent. of metal, we imported 14,083 tons, on which the amount of duty was 5460*l.*, charged on 1733 tons of metal; under 20 per cent. and more than 15 per cent. 13,304 tons, duty 10,339*l.*, charged on 2188 tons of metal; and, above 20 per cent., 26,969 tons, duty 48,630*l.*, charged on 7719 tons of metal.

Our importations of tin have been as follows:—

Countries from whence imported.	Tons.	Cwt.	Qrs.	Lbs.
Holland,	14	3	2	8
Gibralter,	0	1	0	0
East Indian Territory,	129	7	0	26
Singapore,	1115	7	2	18
Java,	272	12	3	17
China,	0	6	0	0
Peru,	27	7	3	21
Total import of foreign tin,	1559	6	1	6

We have exported 1819 tons of British, and 650 tons of foreign tin —of which France has taken 626 tons, Russia 480 tons, Italy 183 tons, Turkey 250 tons, and the remainder distributed among twenty-seven places.

Of foreign zinc, we have imported as follows:—

Countries from whence imported,	Tons.	Cwt.	Qrs.	Lbs.
Denmark,	268	19	2	21
Prussia,	6860	15	3	22
Germany,	3000	1	2	11
Holland,	20	3	2	1
Belgium,	21	0	0	9
Syria and Palestine,	1	15	0	15
Total import of foreign zinc,	10,173	4	3	23

Of this we retained for home consumption 4102 tons, on which the net duty was 223*l.* 2*s.* 10*d.*; and we have exported 1395 tons of British, and 6445 tons of foreign spelter.

Of foreign lead, we have imported 2863 tons—of which 2775 tons were pig and sheet, 68 tons ore, and 19 tons white lead; 157 tons were retained for home consumption, on which the duty was 165*l.*; and we imported from the Isle of Man, duty free, 2415 tons of lead ore. Our exportation of foreign lead amounted to 2439 tons—while of British we exported 176 tons of ore, 14,610 tons pig and sheet, 378 tons litharge, 707 tons red lead, and 1224 tons white lead—making a total of 17,097 tons.

Lond. Min. Journ.

Copper Mining in Cornwall.

Fowey Consols.—This sett, which is 1500 fathoms in extent on the

run of the lodes, and extending 300 fathoms north and south, is held at 1-24th dues for the western ground, which includes the old Lanescot Mines—and at 1-16th for the eastern part, but which, it is expected, will be reduced to 1-24th, as the lease is drawing to a close, and negotiations pending for such abatement on renewal. The mine presents at surface the most complete and efficient arrangements for economizing labor, the buildings, dressing floors, &c., with yard for stores and ware-houses, smiths' and carpenters' shops, &c., being immediately under the eye and control of the agents. The principal power employed here is by means of water-wheels and hydraulic engines, the combined power of which is 556 horse, which does not embrace the whole of the power which is available.

The following is a description of the several water-wheels:—

Name.	Diam. feet.	Breadth. ft.	Breadth. in.	Horse power.	Application.
Remfry's wheel,	30	3	6	32	Drawing ores to surface, also coal, timber, &c., from canal over incline plane, and tunnel, 900 yards long.
Old stamps wheel,	19	4	0	22	Stamping halvans, and working incline plane for drawing ores to crusher.
Timber sawing wheel,	27	2	6	18	Twelve vertical and one circular saws; power for twenty, if necessary.
Sampson's wheel,	24	3	0	27	Drawing ores to surface.
Old grinder wheel,	24	3	8	30	Crushing.
Separator wheel,	24	1	9	15	Jigging.
Great grinder wheel,	27	6	0	60	Stamping.
Wheal Hope wheel,	40	3	6	60	Stamping.
New stamps wheel,	30	6	0	65	Stamping.
Tremayne's wheel,	24	4	0	27	Drawing.
Fitting up wheel,	14	2	6	5	Turning lathes, &c.
New separator wheel,	12	1	6	4	Jigging.
Pidler's wheel,	34	5	0	60	Pumping.

Giving a total of 425 horse power by water-wheels. To this is to be added the hydraulic engines employed in pumping; these are three in number, viz., Bottrall's 24-inch, equal to 49 horse power, with column of water 30 fathoms in height; Union, 22½ inch, 52 horse power, column 45 fathoms high; and Hodges', 18 inch, 30 horse power, with column of 19 fathoms; thus making the total water power equal to 556 horse.

The steam engines employed consist of—

Name.	Cylinder. inches.	Length of stroke. ft.	Length of stroke. in.	ft.	in.	Horse power.	Application.
Austen's,	80	10	4	9	3	200	Pumping.
Davis',	22	5	0	5	0	30	Drawing.
Powne's,	22	5	0	5	0	30	Drawing.
Trathan's,	20	4	0	4	0	22	Drawing.
Ray's,	18	4	0	4	0	15	Drawing.
Hodges',	24	5	0	5	0	30	Drawing.

It will thus be seen, that in addition to the water power, the steam employed is equal to 327 horse power, estimated according to Boulton and Watt's calculation—but which is considerably greater with the Cornish improvements; thus making, in the aggregate, a power

equal to 883 horse applied at surface. The quantity of water brought to the mine by leats is estimated at not less than 25,000 gallons a minute in the winter season, and about 10,000 in the summer.

The number of lodes discovered and worked upon exceed twenty, of which workings are now being carried on thirteen, or fourteen; there are six engine shafts, the principal of which (Austen's) is sunk to a depth of 180 fathoms below adit, which is, at this particular point, about forty-five fathoms from the surface. The quantity of ore sold in 1842, was 12,446 tons, yielding 73,214*l.*, or 5*l.* 17*s.* 6*d.* per ton—the amount divided between the adventurers being 6400*l.* In the past twelve months ending December, 1843, the total quantity of ore was 13,450 tons, or an excess of about 1000 tons, which realized 80,852*l.*, or 6*l.* per ton—the dividends paid to the adventurers being 9728*l.* It may here be mentioned, that, after payment of the first outlay, a sum slightly exceeding 200,000*l.*, has altogether been realized as surplus, in which, however, is included the reserve fund, applied to working the mine; this is exclusive of the value of the machinery and appliances, which may be fairly estimated at 60,000*l.* The mine, since the great increase of the foreign ores, and the consequent fall in the standard, by stopping numbers of old pitches, which cannot work at a low standard, has fallen off in its surplus returns—the quantity of ores raised in 1838, being 15,771 tons, which yielded 95,190*l.* in money, or 6*l.* 0*s.* 6*d.* per ton—the dividends declared in which year were 17,408*l.*, being nearly double the amount divided in the past year. The number of persons employed is from 1700 to 1800, and which may be thus divided:—agents, engineer, and dialler, 17; tributers, 420; tut workmen, 310; sumpmen, day laborers, and boys, underground, 175; laborers at surface, paid by day, 180; women, boys, and girls, at surface, 670—or, in all, 1772. The following may be taken as the average rate of wages paid:—tributers, who work away the lode, earn about 2*l.* 12*s.* per month—the rate of earning being, in some instances, double that of another, arising from the nature of the ground, and the comparative productiveness, or poverty, of the lode; tut workmen, who are employed by bargain in driving ends, sinking shafts, winzes, &c., earn about 2*l.* 15*s.*; the sumpmen may be set down at 3*l.* 10*s.* per month, the increase arising from the nature of the work, which is ofttimes attended with considerable danger, and at all times may be said to be the hardest duty in the mine; the boys underground, 17*s.* 6*d.*; day laborers, or men employed underground, not by bargain, 50*s.* per month, and those at surface, 40*s.*; boys at surface average 20*s.*, and maidens average about 16*s.*, being as low as 8*s.* 6*d.*, and as high as 23*s.* 6*d.* A deduction is made from the earnings towards the sick club, and for medical attendance. As illustrative of the economy observed by the application of mechanical power, it may be remarked, that not more than two or three horses are employed. The length of the inclined plane from the mine to the canal communicating with Par Harbor, is about 900 yards, the incline being in perpendicular height 280 feet; the other incline on the mine for drawing ores to the crusher, is 220 yards in length, and another inclined plane, on the self-acting principle, which takes all the ores of

the mine to the canal in its way to Par Harbor, is 1127 feet long, and 80 feet in perpendicular height. We must needs defer until our next, further observations on this mine and the district.

Ibid.

Remarks on the Theory of Arches, made before the Institution of Civil Engineers, London. By GEORGE RENNIE, *Esq.*

Mr. Rennie concurred in the accuracy of the description of the Wellington Bridge; it presented an excellent example of theory and practice, not only on account of its strict conformity with the principles of equilibrium, but from the correctness with which the works had been executed, as was evinced by the small subsidence of the arch after the centres were struck. Respecting the theory of the arch, writers were nearly agreed upon the principle established by De la Hire, upon the equilibrium of a loaded chain, or of a series of voussoirs, or wedges, with polished touching surfaces, as shown in his "Traité de Mécanique," in 1695.* The subject had been variously demonstrated by writers, but with little effect; architects were forced to select examples at random, for which no precise rules existed; but any persons on examining the actual state of an equilibrated arch of solid materials, or of a substantial chain suspended at its extremities by points, would immediately perceive the difference in the curves, or loads, on the extrados, arising from the want of sensibility in the arch, or, in other words, from friction and adhesion. Hitherto theory had been unable to comprehend these retarding forces, which had actually been so serviceable to the architect. Perronnet was, perhaps, the first to throw any real light upon the subject; the experiments that he undertook, on the absolute strength of materials, in the year 1758, previously to the commencement of the celebrated bridge of Neuilly,† and, subsequently, those by Gauthey, on the failure of the piers of the church of St. Geneviève,‡ at Paris, were very instrumental in the advancement of the art. It was, however, chiefly owing to the good quality of the material, that Perronnet was enabled to surmount the difficulties which arose from the unusual subsidence of the arches in the bridge of Neuilly. The splaying of the arches, by which a double curvature was given to them, and which had been injudiciously copied in this country, was neither justified by science nor practice. The results of the French experiments were much too slow in reaching this country, and the strength of building materials was but little attended to, until within a recent period.

In the year 1824, the late Dr. Thomas Young, having engaged to contribute the article "Bridge," to the Supplement of the sixth edition of the "Encyclopædia Britannica," applied to Mr. Rennie, to furnish the particulars of the Waterloo and Southwark bridges, then just completed; when, finding the data insufficient, Mr. Rennie undertook

* "Traité de Mécanique." De la Hire. 12mo.: Paris, 1695.

† "Description des projets et de la construction des Pons de Neuilli, de Nantes, d'Orléans &c." Perronnet. 4to.: Paris, 1778.

‡ "Construction des Ponts." Gauthey. 4to: Paris, 1809.

a series of experiments on the absolute and relative strength of materials, part of which he communicated to Dr. Young, and he, subsequently, published the whole in the Philosophical Transactions for 1818.* The results were then applied to the calculations, on the lateral thrust of the arches of those bridges, perhaps for the first time in this country, and which were more amply applied afterwards to bridges in general, by Mr. Ware, and his tables of the relative boldness of brick, stone, and iron bridges, were valuable accessions to our knowledge on this subject.† As regarded the friction of arches, Mr. Rennie found that the arch stones of Waterloo and New London bridges commenced gliding, or pressing, upon the centres, at angles of from 33° to 34°; he believed that soon after the adhesion of the mortar commenced, the centres would have very little pressure on them, even from stones at an angle of 45°. As to the gliding of the arch stones at the haunches, from the pressure of the upper voussoirs, he had never seen an instance of it; but he had seen the haunches so much eased from the centres, by the lateral action exerted in driving the stones into the vertex of the arch, as to allow the lagging, or cross bearers above the ribs, to be taken out. This proved the correctness of the rotative system of voussoirs, as shown by experiment. With respect to adhesion, Mr. Rennie had seen its effect on broken arches of considerable magnitude, among the buildings of Rome, and also in the bridge of Alcantara, over the Tagus, where the centre arch, of nearly 100 feet span, had been blown up by the French, leaving the adjoining arches and piers, which were upwards of 90 feet in height, standing perfectly undisturbed. With respect to the magnitude of arches, M. Perronnet expressed himself confident that arches of 500 feet span could be safely executed. The bridge which he proposed to construct, over a branch of the Seine, at Melun, consisted of a segment of a circle of 400 feet. The experience he had derived from the length of the primitive radii of the arches of the bridge of Neuilly, and his experiments on the strength of materials, would appear to justify so bold an experiment.

Mr. Rennie was of opinion, that with our strong magnesian limestones and hard granites, arches of larger span than any hitherto built, might be safely constructed. There were numerous examples, both in ancient and modern times, of very large arches. The bridge of Narni, in Italy, of Vielle Brioude, in France,‡ and of Alcantara, in

* Vide "Philosophical Transactions," 1818, p. 118.

† Vine "A treatise on Arches, and their abutment piers," by Samuel Ware. 8vo: London, 1809.

‡ The following dimensions of the Pont de Brioude, are given in a letter from M. Seguin to Mr. Rennie, dated Feb. 27, 1827:—"The ancient bridge was constructed by the Romans, for the use of foot passengers, pack mules, and small carts drawn by oxen.

	Metres.		English feet.
Length of the arch,	56	=	183.730
Breadth "	5	=	16.005
Height "	18 to 19	=	59.058 to 61.339

"The arch was a segment of a circle, formed of volcanic stone, of little consistence. The bridge gave way in the course of time, but was upheld for fifteen years, by means of buttress walls, 6 metres (= 21.68 English feet,) in thickness, and 10 metres, (= 32.8 English feet,) in height; and also by bars of iron, fixed in the wing wall, and through several courses of the

Spain, by the ancients; and those of Gignac, and of Castel Vecchio, by the middle ages; but the most remarkable example of cylindrical vaulting, (the remains of which still existed) was the bridge of Trezzo, over the Addu, in the Milanese.* The span was 251 feet over the chord, and 266 feet over the semi-circle. The stone beams in the church of the Jesuits, at Nismes, and those between the towers of Lincoln Cathedral, the former equal to the segment of an arch of 565 feet span, and the latter to one of 262 feet span, proved how much could be done with materials of small dimensions.† In modern times there were examples of bold vaulting in France, in the bridges of Neuilly, Mantes, St. Maixence, and Jena; in Italy, in the Ponte Sta, Trinita, Turin; in England and Wales, in the bridges of Llanrwst, of Pont-y-tu-Prydd, of Gloucester, of Chester, and those of London and Waterloo, over the Thames; independently of numerous arches and viaducts, more recently erected for the use of railways. The radii of curvature of the centre arch of New London bridge, taken near the vertex, would equal, in boldness, an arch of 333 feet; and the length of the key-stone, at 4 feet 9 inches, would make the depth only $\frac{1}{70}$th of the whole span.

The origin of the arch had occasioned much controversy. The subject had been learnedly investigated by Dutens, Le Roy, King, and others, but, apparently, to little purpose, as the invention of the arch would now appear to be, with more justice, attributed to the Egyptians, as they seemed to have used it many centuries before the Christian era. The researches of modern travelers, particularly those of Sir Gardiner Wilkinson,‡ proved that the brick arch was known in Egypt in the reign of Amenoiph I, 1540 years B.C., and the stone arch in the time of Psamaticus II, 600 years B.C. "The most remarkable," says Sir Gardiner Wilkinson, "are the door-ways surrounding the tanks of Assassief, which are composed of two, or more, concentric semi-circles of brick, as well constructed as at the present day, and all the bricks radiate to a common centre." Mr. Hoskins was of opinion, that arches were constructed long anterior to the time of the Ptolemies; for in the pyramids of Ghebel Birkel and Dunkalie, which were of more ancient date, both round and pointed stone arches were discovered. Mr. Perring stated that he found at Thebes, some remarkably well formed arches of 12 to 14 feet span, built in concentric half brick rings, the bricks of which were marked with the name of Sesostris; consequently they were upwards of 3180 years old.‖ A

arch-stones. The structure finally fell, and a new stone bridge has been erected upon the same site, of which the following are the dimensions:—

	English feet.
Opening of the arch, which is a semi circle,	150.9
Breadth of "	24.7
Height from the stream to the pavement,	83.7

* A section of this arch is shown in Part I, of the "Theory, practice, and architecture of Bridges." Hann and Hosking. 8vo: Weale. London, 1839.

† Robinson, in his "Travels in Palestine," mentions the remains of an arch over the valley of Kedron, at Jerusalem, supposed to have been 350 feet span.

‡ "Manners and Customs of the Ancient Egyptians." Wilkinson. 3 vols., 8vo: London, 1837.

‖ Vide Minutes of Proceedings, Inst. C. E., for 1843, p. 170.

representation of the tomb of Saqqura, and its arched vault of stone, was given in the vignette of the tenth chapter of the third volume of Sir Gardiner Wilkinson's "Manners and Customs of the Ancient Egyptians." The arch seemed to have been known to the Etruscans; and from the representations of their palaces, and their sea-ports, the arch appeared generally to have been employed for moles and jetties. With reference to the knowledge of the arch among the Greeks, opinions were very contradictory. The researches of modern travelers had brought to light many curious remains of Cyclopean, or Pelasgic, architecture; but in confirming the descriptions of the ancient cities of Mycenæ and Orchomenos, they had left us still in ignorance as to their actual knowledge of the arch.

Mr. Rennie exhibited a series of lithographic prints, from drawings made by the late Mr. Dodwell, during his travels in Greece. They displayed the various door-ways of Pelasgic fortifications, from the lintel of single stones resting on upright jambs, to the overlapping of the stones until they reached each other, in the form of a triangle, as in the gate of the lions, the entrance into the treasury of Atræus, &c. But the most remarkable monument was the subterranean chamber, of which Mr. Dodwell's lithographic plate gave an imperfect idea; complete plans and sections of that extraordinary building were given by Mr. Donaldson, in the supplement to the "Antiquities of Athens,"* from which it appeared to have been constructed in the form of a parabolic cone of 48 feet in diameter at the base, and 44 feet 6 inches in height, by means of rings of regular masonry, overlapping each other until they reached the apex, where the aperture was closed by a flat stone. From this, and other buildings of a similar kind, there was reason to infer that the ancient Greeks had very imperfect notions of the arch. Mr. Kinnaird, in his "Description of the Antiquities of Delos,"† gave a representation of a portal, or gateway, on the ascent of Mount Cynthus, formed to support the wall of the ancient fortifications. The entrance was constructed with ten large stones inclined to each other, like those at the aperture into the great Egyptian pyramid. It was, perhaps, the earliest specimen of Pelasgic architecture in Greece, displaying the first step towards the principle of the arch. That it was known by the Etruscans, seemed evident, from the remains of arches and bridges, now existing in the country of the Volsci in Italy; and the researches of travelers in that country, within the last few years, had brought to light many curious examples, anterior to the period of the Cloacæ of Rome, and the tunnel of Albano, by Ancus Martius. Mr. Rennie was of opinion, from his examination of the subject, that there existed no sufficient evidence to establish the knowledge, or use, of the arch among the Greeks.

Mr. Page presented two sketches made by him of two arches at Cape Crio, (Cnidus, Rhodes.) These arches were semi-circular, built of large stones regularly radiating from a centre, without any mortar in the joints, and stood among Cyclopæan remains, of which they apparently formed a part. He was of opinion, that the Greeks were

* "Antiquities of Athens," &c. Stewart and Revett. Supplement. Folio. London, 1830
† "Antiquities of Athens," &c. Stewart and Revett. Supplement. Folio. London, 1830

aware of the properties of the arch. They evidently appreciated its form, for it must have been noticed by all travelers, how frequently the flat lintels were cut out on the under side; several specimens of this existed in the sepulchral remains now in the British Museum. At Athens, he had noticed a very considerable excavation of a regular arch form through solid marble.

Mr. Rennie observed, that as more useful lessons were given by failures in construction, than by records of successful undertakings, he had caused a large drawing to be made of the bridge of Boverie, at Liège, showing its state at the time of the report upon it, by the commissioners appointed by the Belgian government, when it was condemned, and was ordered to be reconstructed, at the cost of the contractor, which, however, had not yet been done. The bridge, which was built of hard, compact, magnesian limestone, consisted of five arches of 78 feet span each, with a versed sine of 8 feet, which was between $\frac{1}{9}$th and $\frac{1}{10}$th of the span. The form of the arch was that of a segment of a circle of 100 feet radius, the angle of the springing was, therefore, 46° 45′. The abutments at either extremity were of rubble masonry, and were very deficient in weight and dimensions. The obvious consequence of this want of due proportion was, that the abutments gave way, all the arches sunk at their centres, many of the stones nearly falling out, several of them were fractured in both directions, serious dislocations occurred in each pier above the springings of the arches, and also down upon the cutwaters, and, in spite of all attempts to remedy the defects, the bridge was condemned, and was taken down, although it had cost upwards of £25,000. It was evident that these flat arches were not well proportioned, and that the abutments were insufficient to support their thrust. It appeared also, from the report of the commission, (of which he presented an abstract, No. 672,) that sufficient attention had not been paid to the quality of the workmanship, or in the selection of the materials employed.

Civ. Eng. and Ar . Journ.

On the Reduction of Inclined to Horizontal Angles. By Lieut. A. G. Edye, *R. N.*

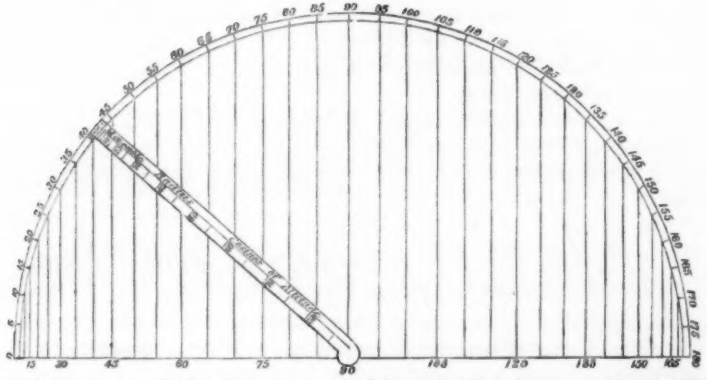
The accompanying simple diagram having suggested itself to me, for the speedy reduction of the inclined angle between the sun and an object, to the horizontal angle, I take the liberty of forwarding it to you, with an example of its application to practice, for insertion in your useful Magazine.

The principles of this diagram are lines of cosines, drawn on a semi-circle, and which I call cosines of distance. To the centre of this semi-circle is attached a movable radius, which is also divided into cosines, called cosines of altitude. The following example will show its use: Suppose the true angular distance between the sun's centre, and the object, to be 45° 0′, and the sun's corrected altitude 20° 0′.

To the *cosine of distance* 45° on the semi-circle, bring the *cosine of*

altitude 20° on the movable radius, and you will find that the extremity of the movable radius on the arc will be found at 41° 12′, within a few minutes, for the reduced angle; if the lines of cosines on the semi-circle and radius are correctly drawn, and their scale sufficiently large, the reading off will be the same as if the operation were performed by logarithms.

The diagram I send you is of small radius, for convenience of insertion, and only divided at every 5°, but for practical use the larger the scale on which it is constructed, the greater will be the accuracy of reading off; every degree and quarter degree, at least, should be drawn in lines of cosines.



A diagram carefully drawn on card board of eighteen inches radius would be found to approach pretty near the truth; but, of course, greater accuracy would be obtained if it were made on a metal plate.

The usual method of reducing Sun's Hor. ∠ is as follows:—

Take, for example, Cor. Dist. Sun, and object 45°, Alt. Sun. 20°.

Dist. 45° 0′	Cosine	9.849485
Alt. 20 0	Secant	0.027014
Red. Hor. ∠ ⊙ 41° 12′		9.876499 cosine.

The principle on which the diagram is constructed, being lines of Cosines,

Dist. 45° 0′	Cosine	9.849485 + 10 to index.
Alt. 20 0	Cosine	9.272986
Red. Hor. ∠ ⊙ 41° 12′		9.876499 cosine.

In the application of this angle to the sun's true bearing, (supposed to be already found) + or — according as the object is to the right, or left, of the sun's centre, it would, in strictness, require a further reduction for the convergency of meridian, but, in practice, under ordinary circumstances, this might be dispensed with, the quantity of correction being but small.—[We commend the foregoing to the attention of nautical surveyors.] **Naut. Magazine.**

AMERICAN PATENTS.

List of American Patents which issued in February, 1844, *with Remarks and Exemplifications. By* CHARLES M. KELLER, *Examiner of Patents.*

1. For a *Washing Machine;* James B. Coffin, Big Prairie, Wayne county, Ohio, February 2.

This machine consists of two sets of horizontal rollers, each set being composed of four, or more, ranged one above the other, with their gudgeons working in grooves so inclined that the weight of the rollers causes those of each set to press, in opposite directions, against the clothes that are attached to a frame, and, with it, worked up and down between them.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the series of rollers placed in oblique grooves with the vibratory frame constructed and arranged substantially as described."

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2. For a *Wheat Fan for cleaning grain;* David Watkins, Port Republic, Rockingham county, Va., February 2.

This improvement is simply a long screen, which may be attached to the shoe of any wheat fan that can give to it a vibratory motion lengthwise.

Claim.—"What I claim as my invention, and wish to secure by letters patent, is the combination of a horizontal extended screen with the wheat fan, said screen to be operated and constructed as described."

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3. For an improvement in the mode of *Propelling Canal Boats;* Henry R. Worthington, New York City, N. York, Feb. 2.

This is claimed as an improvement on a mode of propelling canal boats, patented by Benjamin D. Beecher, on the 31st of December, 1839, and noticed at page 111, of the first volume, third series of this Journal, to which the reader is referred.

Instead of the two screw propellers employed at the bow, by Beecher, under the present patent, there are two paddle-wheels, one on each side of the bow, and either the shafts of these wheels are so inclined as to form a right angle with the general planes of the bow, or the shafts are at right angles to the keel, and the plane of the paddles so inclined as to strike the water at right angles to the general planes of the bow.

The object of this improvement is obviously to carry the current of water, generated by the paddles, in a direction that shall not impede the passage of the boat, instead of throwing it against the bow.

Claim.—"What I claim is the combining with a canal, or other, boat, having bows formed in the ordinary way, of two propelling

wheels constructed as herein described and represented, and in the manner made known; said wheels being located at, or near, the bows, and in advance of the greatest sectional width of the boat, their buckets also being so arranged that the plane of their surfaces, when vertical, and acting upon the water, shall be at right angles, or nearly so, with the general line of the vessel's bow, that they may displace, or divide, the water, and cause it to pass off from the bows of the boat in the direction designated, and for the purpose set forth."

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4. For an improvement in the *Roller-Gin, for ginning Cotton;* Richard Reynolds, jr., Beaufort, South Carolina, Feb. 2.

In this gin there are two fluted rollers of nearly the same size, and a large, smooth roller. The two small rollers are arranged one above the other, and in front of the large roller, the axis of the upper small roller being nearly on a level with the axis of the large roller. The bearings of the small under, and the large, roller work in sliding boxes provided with springs, by which they are both pressed against the small upper roller, so that the cotton passes in between the upper and lower small rollers, and then between the upper small roller and the large roller behind it. In the following claim, the upper small roller is designated by the letter *b*, the small roller below it by the letter *c*, and the large one by the letter *f*.

Claim.—"I do not claim, as my invention, the employment of these rollers together, as this has been done for burring wool, and for other purposes, but what I do claim as my invention, and desire to secure by letters patent, is the manner in which I have arranged the three rollers, *b*, *c*, and *f*, so that the cotton shall enter between the small rollers *b* and *c*, and then pass between the roller *b*, and large roller *f*, by having them so arranged that the rollers *c* and *f*, are pressed by the springs against the roller *b*, as described."

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5. For an improvement in the *Vibrating Steam Engine;* Ebenezer A. Lester, Boston, Mass., Feb. 7.

We have here a modification of the well known vibrating engine. It is suspended by trunnions, or gudgeons, at the upper end of the cylinder, and the piston rod passes out through the lower end of the cylinder, and extends from thence to the crank below. The upper cylinder head is of a semi-cylindrical form, and fits and vibrates in a corresponding cap attached to the frame, and in these are formed the various steam chambers and ways, so arranged, that by the vibrations of the cylinder the induction and eduction passages are opened and closed. The action of the engine can be reversed by means of a three way cock in the head of the cylinder.

Claim.—"What I claim as my invention, and for which I ask a patent, is the manner of arranging and combining the steam chambers and the channels, or steam-ways, in the top piece, and the upper cylinder head, the said top piece and cylinder head being fitted to each other by their concave and convex cylindric surfaces, so as to cause the said steam-ways, or channels, to operate by the vibration of the

suspended cylinder, substantially as herein set forth. And this I claim, whether the engine be constructed so as to operate without a three-way reverse plug cock, or valve, or if made, or constructed, to be capable of reversing its motion by means of such plug cock, or cocks, as described."

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6. For an improvement in *Flasks for Moulding Hinges*; Thomas Loring, Gloucester township, New Jersey, Feb. 7.

The patentee says,—"The flasks that I use are of that kind which enables the moulder to form any required number of moulds, by the use of one single pair; said flasks being hinged together at their corners, so that when a mould has been formed, the flask can be removed therefrom, and used for the formation of another."

"I connect the upper part, or cope, of the flask to the drag, or lower part, by means of an elastic spring hinge, or joint piece, which is so formed and combined with the two parts of the flask, that when these parts are closed upon each other, without any thing between them, they shall fit together and form a close joint, the two parts being adjusted by means of pins, or ears, and being held together by means of hooks, or clasps, in the usual manner, when they are made ready for receiving the molten metal. The said spring hinge will also enable the two halves of the flask to close correctly upon a metallic card, when it is placed between them, so as to be ready for the hands of the moulder, its elasticity being such as to admit the flasks to recede to the distance of an eighth of an inch, more, or less, from each other."

Claim.—"What I claim as new, and desire to secure by letters patent is the connecting of the two parts of the flask together, by means of a spring hinge, formed and operating substantially as described, so that by its aid the flask may be closed, either with, or without, the piece of metal, called a card, between the two parts, as set forth."

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7. For a mode of *Hanging Sliding Doors;* Wm. T. Forsyth, Philadelphia, Pa., Feb. 12.

This is an improvement on double sliding doors, generally employed to form the communication between two parlors: instead of making them to run on an iron rail, as heretofore, they are suspended by means of rollers, or jaws, to a rail above, so that the lower part may not touch and drag on the floor.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of suspension doors, &c., upon a suspension bar, by means of rollers and jaws, or clamps, or by any other analogous device, the whole being constructed and operating substantially as set forth."

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8. For an improvement in the *Rotary Steam Engine;* Abram Pease, Lyons, Wayne county, N. York, Feb. 12.

This patent is granted for an arrangement of parts to open and

close the valves of a rotary steam engine. The valves are provided with connecting rods, the outer ends of which are jointed to cranked arms, which cranked arms are jointed to two arms projecting from opposite sides of the shaft of the engine. That end of the cranked arms that is jointed to the connecting rods, is provided with two rollers that embrace a bent rim, or annulus; and, as the arms rotate with the shaft of the engine, the valves are opened and closed by the bend in the rim, or annulus.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method herein set forth, of governing the connecting rods which operate the valves, viz., by attaching the said rods to the cranks, connected with the arms on the shaft in combination with the curved rim, the same being constructed and operating substantially as described."

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9. For an improvement in the *Cooking Stove;* James Young and Elmon Parker, Philadelphia, Penna., Feb. 12.

From the back of the stove two pipes rise, one near each end, and run into a horizontal cylinder placed above the stove, in the manner of the elevated oven well known to stove makers. Within this cylinder there is a concentric cylindrical boiler of a diameter so much less than the cylinder, as to leave a sufficient space for a flue which surrounds the whole. The draught passes up through either, or both, of these pipes into the space between the boiler and cylinder, and thence into a pipe at the top.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination of the boiler with the elevated and concentric flue, or smoke-pipe, constructed and arranged as described."

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10. For an improvement in the *Straw Cutter;* Wiltham Hovey, Worcester, Mass., Feb. 12.

"The nature of this invention," says the patentee, "consists in forming a cylinder, around which a series of knives are set spirally, the said knives being radial, and so fastened to the cylinder as to be adjustable, by which means they can be made to cut against a cylinder, or roller, of wood, or other suitable substance, with the greatest precision, after they have been ground.

"I do not claim a cylinder of knives cutting against a solid surface, as that has been done before, but what I claim as my invention, and desire to secure by letters patent, is the cylinder having any number of arms around it, to which adjustable knives are affixed and arranged, as above described, in combination with the roller against which they cut, in the manner and for the purpose described."

The manner of attaching the knives, referred to in the claim, is simply making as many arms on each end of the stock as there are knives, and fastening the knives to them by means of screws that pass through elongated slots in the knives to admit of adjustment.

11. For an improvement in *Cooking Stoves;* Jordon L. Mott, New York City, New York, February 12.—Ante-dated December 1st, 1843.

The patentee says,—"My improvement is applicable to cooking stoves of different kinds, as it may be applied wherever boilers, or other cooking utensils, are placed, or a boiler plate situated over the fire chamber by which they are to be heated. It consists in the employment of a lid, or cap, and of two jambs, which are made to open and close simultaneously, by their combination with each other; and which, when closed, form a compartment within which the cooking utensils are enclosed, excepting towards their fronts, thereby preventing the escape of steam, and other vapors into the room, and causing them to be conducted off; there being an opening, or escape flue, at the back of said compartment, leading into the stove pipe, or chimney.

"What I claim therein as new, and desire to secure by letters patent, is the so combining of a cap and jambs, situated in the manner, and employed for the purpose, herein set forth, as that they shall be made to open and close simultaneously, by the raising and lowering of the cap; the hinge joints and levers by which the same is effected, being constructed and arranged substantially as set forth; not intending, however, by this claim, to limit myself to the precise formation of the operating parts as represented, but to vary the same as I may think proper, whilst I attain the same end by equivalent means."

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12. For an improvement in the *Cooking Stove;* Simon Pettes, Schenectady, New York, Feb. 12.

In this stove the fire chamber is placed above the oven, and at the back of the stove there is a diving flue, which leads the draught down to the space between the bottom of the oven and the bottom plate of the stove, which space is divided into three flues, by means of two plates "extending about three-fourths the length of the stove—the ends next the front being wider apart than those next the diving flue, so as to make the flue gradually increase in width." This arrangement divides the space into three flues, the middle one receiving the draught from the diving flue, and discharging it into the two side flues, from whence it passes into a rising flue back of the diving flue. The diverging position of these two plates not only makes the middle flue wider at the outlet end than where it is connected with the diving flue, but gives the same character to the two side flues also.

The patentee informs us that "flues thus enlarged as they approach the outlet, are found to draw better than those of a uniform width, or contracted as they recede from the fire chamber."

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is combining a diving flue back of the oven, and the diverging plates, connected therewith, placed under the oven with the stove, as described, the whole constructed and operating as set forth."

13. For an improvement in the *Corn Mill;* Geo. T. Walters, Nicholasville, Jesamine county, Ky., Feb. 12.

This is for an improvement in the mill for grinding corn with the cobs. In the eye of the mill there is a conductor to receive and deliver the ears of corn to be cut by a set of knives, one being attached to and moving around with the runner, and four others attached to the bed stone at equal distances apart, and placed tangentially to a circle of less diameter than the eye of the runner.

Claim.—"I wish it to be understood, that I do not claim stationary knives in the bed stone, as that has been done before, but what I do claim as my invention, and desire to secure by letters patent, is the movable, adjustable knives placed tangentially, in combination with the revolving knife, situated under the balance rind, and attached to the spindle, all constructed and arranged substantially in the manner and for the purpose described."

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14. For an improvement in *Moulds for Casting Butt Hinges;* Benjamin F. Harley, and John W. Morris, Philadelphia, Pennsylvania, Feb. 12.

The patentees say,—"In the old mode of casting butt hinges, separate cores, or chills, were used, in order to form the sand mould of the knuckles of the joint of the hinge. Our invention is designed, principally, to dispense with the cores, or chills, which have heretofore rendered the casting of the half hinge very imperfect. By our method the mould, or drag, of the half hinge is formed at once, by a simple operation, directly from the pattern, and without any draft whatever, producing a mould in which a perfect half hinge may be cast. And this we accomplish by the use of a plate which has a vertical movement, and which is perforated with an aperture of a shape corresponding with that of the pattern of the half hinge, which pattern is placed in the said aperture, in a horizontal position, during the operation of filling the flask with sand."

It is obvious that the sand being filled in, and rammed over the pattern, and on the top of this movable plate, the plate can then be lifted up from the pattern with the sand, or drag, which is thus sustained, and the edges prevented from breaking off by the friction against the sides of the pattern.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the method of forming the drag, or bottom, part of the mould directly from the pattern for casting, as before described, or by any other mode substantially the same; that is to say, by the use of the movable plate for lifting the mould from the stationary bed, or pattern, thus dispensing with separate cores, or chills."

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15. For improvements in the *Stocking Loom for Knitting Stockings, &c.*, Richard Walker and Jefferson McIntire, Portsmouth, Rockingham county, N. Hampshire, Feb. 12.

The patentees say,—"In the knitting loom which we have invented,

our first improvement consists in the substitution of horizontal sliding stitches for the falling jacks, or sinkers, heretofore employed, by which means the friction is diminished, and this part of the apparatus is simplified, and much less liable to get out of order than the falling jacks. Our second improvement consists in the manner in which we arrange and operate the needles, said needles being placed vertically, with their backs towards the front of the frame, and the depresser behind them, under the stitches; by which arrangement the work is elevated, and exposed to the eye of the operator at all times."

The second of these improvements is the necessary consequence of the first, for a change of position of the stitches requires a corresponding change in the position of the needles; and, although this change of position of the stitches and needles is considered the essential part of the improvements, the claim is limited to the method of moving the stitchers, which is effected by means of a bar, or regulator, which lies between two shoulders on the stitchers, and which, by its movement back and forth, gives them the required movement.

Claim.—"What we claim as new, and desire to secure by letters patent, is the manner in which we have arranged and combined the regulator, or bar, with the stitchers, so that said bar will, by its vibration, move said stitchers back and forth, by its action between the shoulders thereof, as described, the horizontal position of the stitches, and the manner of combining the bar with them, rendering it unnecessary to use springs, or any analogous device for retracting the stitchers."

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16. For an improvement in *Conical Balance Valves for Steam Engines;* Thomas McDonough, Middletown, Middlesex county, Connecticut, Feb. 12.

The following is the description of this improvement, given in the specification, viz.,—"The nature of my invention consists in connecting the conical valve with the well known balance piston, by means of a hollow stem, so that the steam can pass through the hollow stem to act below the balance piston, and thus always have an equal pressure on the upper side of the valve, and lower side of the piston, and on the lower side of the valve, and upper side of the piston. The valve to be placed, as usual, in a chest, and the piston in a cylinder, either above, or below, the conical valve."

Claim.—"What I claim as my invention, and desire to secure by letters patent, as an improvement on the well known conical balance valve, is connecting the valve with the balance piston, by means of a hollow stem, as described."

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17. For a machine for *Breaking Coal;* Joseph Battin, Philadelphia, Penna., Feb. 12.

We make the following extract from the specification of this patent, viz.,—Improvement in the manner of combining and arranging the toothed rollers used in the machine for breaking coal, which rollers,

as combined and arranged by me, are described, as follows, in the specification attached to letters patent for a machine for the effecting simultaneously the breaking and screening of coal, granted to me under date of the 6th day of October, 1843. The breaking part of my machine consists of two rollers of cast-iron, the peripheries of which are provided with teeth, so placed as that in the revolution of the rollers the teeth of each of them shall stand opposite to the spaces formed by two contiguous teeth on the opposite roller. These rollers are geared together in order to cause them to preserve the same relative positions. In the above named letters patent, this manner of arranging and combining the toothed rollers was not made the subject of a claim, the said patent having been obtained for the combining of a roller breaking machine with a screen, for separating the coal into different sizes required; but as the breaking rollers, so formed, arranged and combined, are applicable to the ordinary cylinder breaking machine, when not used in combination with a screen, and as I have found, by continued experiment, that such rollers constitute a real improvement in any breaking machine, I have determined to secure to myself the benefit of such improvement in a distinct and separate patent therefor.

"Rollers for the breaking of stone, of ores, of coal, of corn, and of other substances, have been frequently constructed, and are well known. Some of these have been fluted, and others have been furnished with projecting teeth in their surfaces, but they have never, as I verily believe, been made to operate in the manner in which my improved rollers operate."

Claim.—"What I claim as new, and desire to secure by letters patent, is the so forming and gearing of such rollers as that the teeth of one of them shall always be opposite to a space between the teeth in the other, whenever they are operating upon the article to be broken, the same being effected substantially in the manner set forth."

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18. For a mode of *Opening and Closing Bee-Hives, called the "Bee Preserver;"* Samuel Cope, and J. D. Cope, Damascoville, Columbiana county, Ohio, Feb. 12.

The hive is to be provided with a lifting gate, suspended by a rod to a crank, on the shaft of which there is a wheel with two stops on it, and a barrel with ratchet, cord, and weights, like a clock, by which it is worked. A stop lever, projecting from an arbor, bears against the stops of this wheel, and prevents it from turning, except when lifted up at stated periods, which is effected by an index wheel, connected with a time keeper, and so formed that the attendant may change the periods of opening and closing the gate. The stops on the wheel are arranged one opposite the crank, and the other on the same side with it, that the wheel may be stopped either when the gate is up, or down.

The claim is limited to the index-wheel, and the stop-wheel, in connexion with a common clock, or other time-keeping apparatus, combined with the gate, for the purpose described.

19. For a *Buckle, or Clamp, for holding, or confining, tugs, straps, braces, belts, &c.;* Julius W. Hatch, Fayetteville, town of Manlius, Onondago county, N. York, Feb. 20.

This buckle, or holdfast, consists of a metal case having a bottom and two sides, with an eccentric roller parallel with the bottom, and having its bearings in the sides. The straps, &c., to be fastened, are passed in between the bottom, when the eccentric roller is so turned as to make the space between it and the case greatest, and then it is turned to compress the straps, &c., between it and the bottom of the case. It must be obvious that after this the tension of the straps must increase the pressure with which the eccentric roller holds it.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the eccentric cylindrical roller with the buckle case, consisting of back, top, and side plates, the whole being constructed and operating in the manner described."

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20. For an improvement in the *Cooking Stove;* S. S. Jones, Philadelphia, Penna., Feb. 20.

There are two ovens in this stove, one above the other, with a plate between the two, to separate the space between them into two flues. The fire chamber is situated in front of the lower oven, with a diving flue between them. There are two dampers, one that commands the flue that leads from the fire chamber over the lower oven, and the other to close either the back, or top, flue of the upper oven. By the management of these two dampers, and the arrangement of flues surrounding the two ovens, we are told that the heat can be carried entirely around either, or both, ovens at pleasure.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement and combination of the flues and dampers, constructed in the manner and for the purpose set forth, so that both ovens shall be entirely surrounded with heat, if desired, without return flues."

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21. For a machine for *Digging Potatoes;* Archibald C. Ketchum, Schenectady, N. York, Feb. 20.

The forward part of this machine is a share, or scoop, with sides and a projecting rounded point, which runs in under ground to dig up the potatoes, which, with the loosened earth, are forced up the inclined surface of the scoop, and delivered on to an inclined endless chain, or belt, composed of iron rods, which passes around two drums, or rollers, that receive motion from a wheel at the side of the machine, the periphery of which is provided with pins to take in the ground, and insure its turning, as the machine is pulled forward by horses, &c.

Claim.—"What I claim as my invention, is the combination of the share, which serves to unearth the potatoes with an endless revolving belt, or chain, serving to screen and separate them from the soil."

22. For a *Composition for Glazing Earthern-Ware;* Thomas and Ephraim Parker, Orangeville, Columbia county, Pa., Feb. 20.

"Take about 150 pounds of lead ore in its natural state, and grind the same, in a common mill, to the required degree of fineness. Then take of common loam about one-fourth, more, or less, of the quantity of the lead ore, and grind it separately, or with the ore; take also of manganese, brass, or copper, filings, in quantity about one-tenth that of the lead, and grind them separately, or with the lead ore, to give the composition the required color, which, in this case, will be black, or green; but if a blue color should be required, smalt should be substituted for either of the above coloring articles. To these add a sufficient quantity of water to give the composition its required degree of consistency, say about as thick as cream, into which the article to be glazed is dipped, or it may be applied in the usual manner. Should verdegris be used with the loam and lead ore to produce a green color, it will not be required to be ground with them, but may be added in its powdered state."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the before described composition for glazing earthenware."

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23. For an improvement in the *Machine for Cutting Straw, Cornstocks, &c.;* Hiram M. Smith, Richmond, Va., Feb. 20.

The knife, which is described as being curved nearly in the form of a sickle, is attached to an arm, or handle, projecting from a shaft, and a little below the knife, and projecting from the same shaft as the handle, is a plate of iron called a guard, but which, in fact, is a gauge, against which the material to be cut is pushed, to gauge the length to be cut off. The cutting and feeding is done by hand in this machine.

Claim.—"What I claim as my invention, is the combination of the guard with the curved knife and arm, constructed and operating for the purpose described."

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24. For an improved manner of constructing *Coupling Bars, for Coupling Railroad Cars, Locomotives, &c.;* Wm. D. Chesnut, Wilmington, New Castle county, Del., Feb. 20.

"My coupling bar has a jaw at each end, which is kept closed by a spring, so as to embrace the coupling bolt, and said jaws are so arranged as that they may play freely to the distance required, by the curvature of the road, but that they shall open and free the coupling bar from the bolt, should one of the connected vehicles run off the track, or be, from any cause, made to deviate a greater distance from a right line than is due to the curvature of the road; whenever such deviation takes place, a pin, or some analogous device, is brought up against a check piece under the platform of the car, or, where a platform is not used, by a check piece, otherwise situated, near the coupling bolt, and the jaws being thereby opened, the coupling bar

will be liberated." The pin, which is above described as striking against the check piece, to liberate the coupling, is attached to the bar, and independent of the spring, so as to separate the bar from the spring, and thus open the coupling, or it may be attached to a lever jointed to the bar, so that when brought against the check piece the lever may turn and force open the spring jaw.

Claim.—"What I claim as new and my invention, is the so arranging of the bar, the spring, the pin, and the check piece, as that the jaw shall be opened when one of the cars deviates from the track; the respective parts being connected with each other, and operating substantially in the manner set forth."

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25. For an improvement in the *Lever Power for Pressing, &c.;* Robert Sanderson, Athens, Ohio, Feb. 20.

A long lever, working on appropriate journals, provided with rails to receive a loaded car, which is drawn by means of cords and a windlass from end to end, as occasion may dictate, constitutes this improved lever power, by means of which presses are to be worked; the said lever being connected with the press in any known manner.

Claim.—"What I claim as my invention, is the combination of the loaded car and rails with the lever, causing it to operate as such for the purpose of pressing, the whole to be constructed and operated as described."

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26. For an improvement in the *Cooking Stove and Baker;* Ashley Hotchkiss, Maryland, Otsego county, N. York, Feb. 20.

In this stove the oven is placed above the fire chamber, with a flue surrounding it. The draught passes in at the middle of the bottom flue, and is divided, half going each way up the side, and along the top flues, to the pipe in the middle of the top. The boiler holes are arranged on the top, and for the purpose of concentrating the heat under them, there are two long dampers in each of the end flues, so arranged that their upper ends can be made to approach each other, and thus render the flues narrower.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the arrangement of the dampers for concentrating the heat to the bottom of the cooking utensils, in the manner and for the purpose set forth."

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27. For improvements in the *Horizontal Paddle-Wheel for Propelling Vessels;* Peter Lear, and Ephraim Buck, Boston, Mass., February 20.

This method of propelling consists of two rotating plates, arranged at the bottom of the vessel, one forward of the other, in the middle, and provided with hinged flaps, or paddles, kept close, or folded up even with the surface of the rotating plates, to which they are hinged, by the resistance of the water during a portion of their circuit, and thrown out by a cam, or inclined plane, during that portion of their circuit in which they are required to act on the water to propel the

vessel. The inner face of each paddle is provided with an arm and roller projecting sufficiently to enable the cam, without projecting below the plane of the wheel, to open the paddle. The cams that throw out the paddles are so arranged, that their positions can be shifted at pleasure, and thus throw them out in any position relative to the length of the vessel; and in this way propel the vessel forwards, backwards, sideways, or quartering.

Claim.—"We claim the combination of the flaps, or paddles, (hinged to the wheel as described,) with the arms and the inclined plane, or cam, of sufficient length to keep the flaps open during that portion of their circuit in which they act on the water to propel the vessel, the whole being constructed as set forth. We also claim the above described manner of arranging two sets of propellers upon a vessel; or with respect to the keel thereof, viz., the placing the one in advance of the other, and in a line, or range, with the keel—or in the direction of the keel instead of the usual method of placing one on each side of the keel, and directly opposite to each other—the aforesaid arrangement effecting various important advantages in sailing and operating a vessel. We also claim arranging the frame, or plate, of the inclined plane, or cam, so that it may be movable, or made to turn on its axis horizontally, or, in other words, we claim changing the horizontal position of the inclined plane, or cam, the same being for the purpose of throwing different paddles of the series into action, and thereby imparting to the vessel, or steam-ship, a lateral, quartering, or other desirable movement, as set forth."

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28. For an improvement in *Combined Water-Wheels for Mills, &c.;* Emerson G. Covel, Glenn's Falls, Warren county, New York, February 20.

The improvement under consideration is a modification of the well known tub-wheel, and consists in having two wheels, one above the other, with the buckets inclined in opposite directions, so that the water after acting on the buckets of the upper wheel, falls and acts on the buckets of the under wheel.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is combining the (upper) section of the water-wheel having semi-reversa buckets, and contracted issues with the lower section, having concave, or cavetto, shaped buckets—the two sections being geared together by bevel gearing, and turning in contrary directions, in a cylindrical flume, by the reaction and percussion of the water confined in said flume, as set forth."

The buckets of the upper section are so curved as to make the spaces between them at the bottom narrower than at the top, and this constitutes the issues referred to in the claim.

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29. For an improvement in *Railroad Cars*, to prevent accidents from what are termed snake heads; Elisha Tolles, New York City, New York, Feb. 20.

This improvement consists in attaching fenders to the bottom of the

car, between, and back, and forward of the wheels, those at the back and front having their under surfaces inclined, and extending from near the tread of the wheels to within a short distance of the car frame. These fenders are a little thicker than the wheels, and their under surface concave, so that they may catch the "snake heads," or bent ends of the rails, and force them into their proper positions on the line of the rails, and thus enable the wheels to pass over them without danger.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application to railroad cars of concave bars attached to the bottom of each car for the preventing of accidents from snake-heads, and broken wheels, &c."

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30. For improvements in machinery for *Laying Rope, and forming, or winding, the same into coils for transportation, or stowage;* Stephen and James A. Bazin, Canton, Norfolk county, Mass., February 28th.

The bobbins with the strands are placed in flyers that travel about a common centre, and rotate on their own axis. The strand from the bobbin passes over a guide, thence around a grooved wheel on a hollow shaft, through which the strand passes to the layer on the end of the main shaft. The hollow shaft has a pinion on it which gears into a cog-wheel on the layer shaft, and the diameters of the pinion and cog-wheel regulate the quantity of yarn to be given out by each revolution of the flyer. There are as many of these flyers as strands in the rope to be layed.

The rope from the layer passes over a drum which regulates its delivery, and from this it passes under and over two pulleys on the vertical shaft of a crane, and thence over a pulley on the end of the long arm, or boom of the crane, which delivers it on to a reel, and as the crane turns freely on journals on the ends of its vertical shaft, the end of the arm, or boom, which carries the rope, is free to move and follow the coils formed on a reel immediately under it.

Claim.—"Having thus set forth our invention, we shall claim the manner of regulating the drawing of the strands from the bobbins, viz., by means of the series of gear wheels, hollow shafts, grooved wheels and guides intervening between the layer and bobbins, the same being substantially as set forth. Also, the mechanism for guiding, or distributing, the rope upon the coiling reel, the same consisting of the reciprocating crane applied to, or used, in connexion with the reel, and constructed and operating substantially as described."

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31. For an improvement in the machine for preparing *Hemp, and other fibrous materials, for Spinning;* William Montgomery, Boston, Mass. Feb. 28.

This is for an improvement on that part of the machine which combs the slivers, by means of "gill pins," on their passage to the rollers and spindle. The gill bars are formed into two endless chains,

as is well known to those acquainted with this branch of manufactures, and the improvement in question is to cause the teeth in leaving the fibres, as they pass around the drum to return, to continue vertical until after they leave the fibres, which is effected by means of a projecting stud on the end of each of the "gill-bars," which is guided by an inclined plane attached to the frame.

Claim.—"I claim the combination of a projecting stud on one end of each of the 'gill-bars,' with a stationary inclined plane, or other suitable bearing stop, attached to the inside of the frame work, which combination causes the 'gill-bars' to turn so much in their bearings in the chain belts, as to make the heckling pins leave the sliver vertically, and without breaking the fibres of the hemp, the whole being as set forth."

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32. For a composition of matter for *Coloring Hair;* Augustus Grandjean, city of New York, N. York, Feb. 28.

This compound, which the inventor calls the "American Brick," from the circumstance, it is presumed, that pulverized brick is one of the ingredients, is composed of well slacked lime, pulverized, four parts, (by weight) oxychloride of bismuth eight parts, venetian red of commerce one part—these three to be well mixed—then add, gradually, eight parts fused yellow protoxide of lead, and then distilled water, which has been rendered slightly mucilaginous with gum arabic. After the gum water has been added, stir the paste carefully for several hours, and after remaining in a suitable vessel for several days, it is to be Americanized, by the addition of well pulverized brick. This compound is to be moulded to the desired shape, and applied to the luckless head.

Claim.—"I do claim as my invention, the above described composition of matter, which I call 'Grandjean's American Brick,' to be made in the manner, as herein described, with the substance and in the parts, or proportions, by weight, as described; but I do not mean to confine myself to the very exact amounts, or parts, by weight, as herein stated, for a small difference in the amount of one, or another, part, may not effect any material difference in the result produced."

And after this follows various precautions and directions, which could only be interesting to those who are passing into the "vale of years" with so much reluctance, that they still desire to retain some of the appearances of youth, and therefore, we deem it unnecessary to add any thing more.

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33. For an improvement in the *Oil-Feeder*, and other articles of a like character; Joseph Benson, Boston, Mass., Feb. 28.

This is an article used in all machine and engine shops, with which the rubbing parts of machinery are oiled. As heretofore made, it consisted of a cylindrical vessel provided with a long conical tube projecting from the top; but it is generally covered with oil that runs down from the end of the tube, and spreads all over; and the improvement in question, consists in providing the oil vessel with a chamber

at the top, having an aperture at the top, of a diameter somewhat greater than the tube which passes through it, to catch the oil that runs down the tube from the discharge aperture, and also in providing this aperture with a tube extending downwards to within a short distance of the top of the oil vessel, so that when it is turned down to pour out oil the small quantity that may have accumulated in the chamber, will be prevented from running out. The top of the oil chamber is provided with two, or more, small apertures, through which the oil, caught by the chamber, descends into the oil vessel.

Claim.—"Having thus explained my invention, I shall claim my improvement in the chamber, which is applied to the reservoir of an oil vessel, or other article of like character, in order to prevent the oil, or fluid, which descends on the outside of the discharging tube from running down upon the exterior surface of the vessel; the same consisting in covering the top, or contracting the sides of the said chamber, where it opens around the discharge tube, and thereby making the upper part of the said chamber, so that when the oil vessel is turned over into a horizontal position, or thereabouts, the oil in the chamber will be retained by the sides and top, or curving sides, alone. And I also claim a conical, or other shaped, tube, in combination with such a chamber, the said tube extending within the chamber, and opening around the discharging tube of the oil reservoir, in the manner and for the purpose set forth; the said chamber having one, or more, holes, or orifices, connecting it with the reservoir; and the whole of the above being constructed and operating substantially as specified."

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34. For improvements in the *Smut Machine* for cleaning wheat, &c.; Jacob W. Brower, Mount Airy, Surry county, North Carolina, Feb. 28.

This is for improvements in that kind of smut machines which consist of beaters that rotate in a vertical cylinder; on the beaters, and attached to their shaft, is a runner furrowed somewhat like a mill-stone, and working against another disk somewhat similar to the bed-stone of a mill, but placed above it. The grain after passing between these, and being rubbed by them, is acted upon by the beaters, and from the beaters it is discharged into the upper one of two inclined spouts connected with a fan blower, the upper of these spouts being separated from the lower by a screen.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the runner having an upper disk which is furrowed on its upper face as described. I also claim the double spout fan, in combination with the above machine, as described."

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35. For a machine for *Digging Trenches and Laying Pipes;* Ezra Cornell, Ithaca, Tompkins county, N. Y., Feb. 28.

This machine has a cutter for making a trench in the earth of the desired depth and width, and in the back part it has a curved groove

through which a lead, or other, pipe passes from a reel above, and by which it is layed; there being a roller behind to cover the trench.

Claim.—"What I claim as my invention, and wish to secure by letters patent, is a furrow, or trench, cutter, in combination with a curved channel, or groove, of one, or more, divisions, (for laying one, or more, pipes at the same time,) as described; and these I claim in combination with the drum, as described, for the purpose of depositing pipe at any desired depth, the whole being constructed and operating as set forth."

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36. For an improvement in *Railroad Cars for turning Curves;* John H. Quail, Philadelphia, Penna., Feb. 28.

The wheels on opposite sides are not connected together by axles passing through, as usual, but each wheel has a separate and independent axle working in a separate frame, and the ends of two such frames, on opposite sides of the car, are jointed together by two cross pieces, so that they can form parallelograms of any desired angle. The two cross pieces are also jointed to the draught bar—this constitutes one truck, and the draught bars of two such trucks are also jointed together by a pin and sloted hole, so that by inclining one draught bar in one direction inclines the other in the opposite direction, and thus by means of their connexion with the jointed cross pieces of the trucks, the axles of all the wheels are thrown in the direction of the radii of the curve. The car frame is supported by means of springs on the frames of the wheels in such manner as to leave them free to turn.

Claim.—"I am aware that the trucks of railroad cars have been so arranged, that the axles of the wheels could be thrown in the direction of the radii of a curve by the draught, or guide, bar, the wheels on opposite sides being either attached to the same, or separate axles; therefore, I do not claim, as my invention, this general principle, but what I do claim as my invention, and desire to secure by letters patent, is the method of effecting this object by connecting the two sides, in which the wheels work, by means of the cross pieces jointed to them, and to the draught, or guide, bar, as described."

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37. For an improvement in the machine for *Cleaning all kinds of Cutlery;* William Vine, city of New York, N. York, Feb. 28.

This is for an improvement on a machine previously patented for this purpose, which consists of two disk brushes on a shaft, and facing each other. These are placed in a case provided with apertures, through which knives and other articles are passed in between the two brushes, which are turned by a crank handle, and supplied with any polishing powder.

The improvements secured by this patent, are substituting for the brushes, disks covered with strips of buff leather with the edges overlapping, and feeding in the polishing powder near the centre of the disks, instead of the periphery, as in the previous machine.

Claim.—"What I claim as my invention, is feeding, or supplying,

the polishing powder at, or near, the centre of the polishing surface, as described. I further claim covering the faces of the polishing wheels with strips of buff leather, cloth, or other similar material, the edges of which strips shall extend loosely over each other half their width, more or less, as described."

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38. For an improvement in the *Rotary Inclined Propeller*, for vessels, &c.; Richard F. Loper, Philadelphia, Penna., Feb. 28.

This propeller has four wings, or paddles, forming a cross, and their planes are at, or near, an angle of forty-five degrees, and instead of having them project from a cylindrical hub, as heretofore, they are all connected together, or made in the solid, and then put on to a shaft, and the propelling surfaces extend entirely down, forming an angle at the junction of the several paddles, by which means the inventor claims that he can obtain a greater amount of propelling surface, within a given diameter, than can be obtained by having the paddles attached to and projecting from a cylindrical hub.

Claim.—"What I claim as my invention is the before mentioned manner of constructing the propellers, by extending their inclined planes, or propelling surfaces, into the hub, or centre portion, of the propeller, as set forth."

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39. For an improvement in the *Churn for making Butter;* Geo. W. Cook, Schenectady, New York, Feb. 28.

This churn consists of a semi-cylindrical case hung on journals, for the purpose of rocking, and inside of this case there are two frames to which paddles are hinged, so that as the cream passes around them in rocking, they are alternately opened and closed.

Claim.—"What I claim as my invention, is the combining with a rocking churn, floats, or paddles, arranged in, and hinged to a frame, as described."

List of Patents granted for Designs, under the third section of the Act of August 29, 1842.

For a *Bust of Robert Burns;* John C. King, January 31, 1844.

For a design to be cast in metal to be applied as an *Ornament to surround Stoves;* Jordon L. Mott, New York City, New York, February 12, 1844.

We do not deem it necessary to insert the description, or claim, as these could not be understood without drawings.

List of American Patents which issued in the month of September, 1841, *with Remarks and Exemplifications. By* CHARLES M. KELLER, *Examiner of Patents.*

(Continued from Page 185.)

13. For an improvement in *Window Fastenings;* Enoch Robinson, and William Hall, Boston, Mass., Sept. 11.

To the lower rail of the upper sash there is jointed a turn button, with a hollow stem, in which is inserted a helical spring and sliding pin, or catch, which is forced, by the spring, towards the spindle on which the turn button works. The under part of this turn button is so formed as to permit the end of the sliding pin to pass out, and to catch in a notch on a hasp attached to the upper rail of the lower sash. The object of this improvement is to hold together and prevent the rattling of the window sashes occasioned by the shrinkage of the wood.

Claim.—"We claim as our invention constructing the fastening end of the lever, or turning button, of a horizontal hollow cylinder, closed at one end by a screw stopper, or otherwise, and arranging in said cylinder a spiral, or helical, spring and loose pin, the whole being constructed and operating together substantially in the manner, and for the purpose described."

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14. For an improvement in the *Water-Wheel for Mills;* Jesse Taylor, Aurelius, Cayuga county, New York, Sept. 11.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the before described construction of the water-wheel in combination with the trunk, collar, and shoot, for admitting the water through the centre of the bottom of the wheel to the interior thereof, and causing it to escape near the circumference through small apertures, which has the effect of turning the wheel in a contrary direction to that of the escape of the water; that is to say, combining with the trunk, collar, and shoot, as aforesaid, a hollow drum, or wheel, constructed with a circular rim, and a concave convex head, fixed to said rim, and to which head the shaft is fixed, and with a bottom which is also fastened to the said rim with a circular aperture in the centre of said bottom for the admission of water, and a series of small apertures near its periphery, in a circle concentric with the circle of the centre aperture for its discharge, the interior being hollow, with a rim made in segments, or less than the outer rim, arranged in a circle concentric with the outer rim, forming a space between the two rims in which are arranged inclined planes over the before mentioned small apertures, the approach to which are also inclined planes formed on the bottom over which vertical heads are fixed, between which and the last mentioned inclined planes, the water passes to the issues from the centre of the wheel through spaces in the inner segment rim, as described."

We deem it unnecessary to add any descriptive remarks.

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15. For improvements in the *Cooking Stove;* James Root, Cincinnati, Ohio, Sept. 11.

This stove is adapted to the burning of either wood, or coal. The fire chamber is provided with triangular grate-bars hung on pivots, and all connected together by means of a jointed bar, by which they can be shaken to discharge the ashes, or turned sufficiently to close the spaces between them, to exclude the air, for the purpose of retaining

fire. There is a large ash-pit below, and the hearth in front is a little lower than the bottom of the grate, the front plate being perforated to feed the fire with air through the hearth. "The boiler holes are arranged on the top, and there is a sliding damper used to open, or close, a direct passage from the upper flue to the escape pipe, when it is not desired to heat the oven. The under side of this sliding damper is elongated, so that when drawn out it shall project to such a distance into the upper flue, as to cause the draught of heated air from the fire to pass in the vicinity of the openings for the rear boilers, which it would not do without this provision."

Claim.—"What I claim as new, and desire to secure by letters patent, is the manner of arranging and combining the respective parts constituting the fire chamber, the ash-pit, and the hearth; said arrangement and combination consisting of the fire chamber and ash-pit separated from each other by the grate bars, and each hung upon pivots, and connected with a handle by which they can be shaken, or closed, at pleasure; and of an independent hearth, not connected with any plate of the stove, except by the brackets used to attach it to the front plate, all as set forth. By which arrangement I am enabled to employ such a grate and ash pit as are herein described, which cannot be done where the hearth plate constitutes a part of that which supports the fire. I claim also the combining and arranging, in the manner set forth, with the boiler space and the oven, and the direct opening to the stove-pipe, a damper, so constructed and arranged, as that when drawn out it shall intercept the draught of heated air, and cause it to pass in the vicinity of the rear cooking utensils."

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16. For an improvement in the *Grinding Mill;* Samuel Sheldon, Cincinnati, Ohio, Sept. 11.

This is for an improvement in the conical mill; to the bottom of the concave there is attached a spout to conduct the ground meal, or flour, to an appropriate recepticle. The spindle of the cone grinder, or nut, necessarily passes through this spout, and to prevent dust, meal, &c., from running down to the oil box at the lower end of the spindle, there is a tube attached to the spout, through which the spindle passes, the upper end of which runs in a groove made for its reception in the under side of the runner, or nut.

Claim.—"What I claim as my invention, is the manner in which I have arranged and combined the spout, the tube, and the nut, or cone, for the purpose of collecting the meal, or other article, that has been ground, and of preventing dust from passing into the oil box, as set forth."

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17. For *Collapsable Vessels for containing Paint and other Fluids;* John Rand, a citizen of the United States now residing in England, Sept. 11.

The vessels heretofore employed for keeping paints, and used by

artists, are made of tin in a cylindrical form, with a small spout at one end, through which the paint is discharged by means of a piston at the other; but the improvement in question is for making these vessels of soft metal, such as grain tin, and after the vessel, or tube, has been filled with paint, the end of the tube is flattened and rolled up, or soldered; the other end being either flattened and soldered, or formed with a small neck provided with a screw cap. The paint is forced out by collapsing, with the hand, the end of the tube opposite the discharge aperture, and as the paint is discharged the back end is rolled up, the metal being sufficiently soft and thin to admit of this. When the neck is not used, the paint is discharged through a small hole made in one of the flattened ends, which can be closed again at any time by pressure.

Claim.—"What I claim is the mode herein explained, of preserving paint and other fluids in close vessels so formed as to allow of portions of such fluids being from time to time withdrawn, and the space previously occupied filled up by the collapsing of such vessels, (or parts thereof,) by slight pressure, and the openings closed from time to time, as described."

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18. For an improvement in the mode of *Binding and Confining Tobacco;* Albert Snead, Richmond, Va., Sept. 11.

Whilst tobacco boxes are under the press, it is necessary to bind them, to prevent the sides from being forced out, and for this purpose, under the present patent, it is proposed to form a rectangular frame with partitions, like a window sash, to divide the main frame into any desired number of spaces, each of the size required to receive a box. These frames are provided with bars and screws, or wedges, for the purpose of drawing them tight.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of the frame and partitions constructed and combined, as described, to binding up and confining tobacco boxes, while they are filled and pressed, during the process of manufacturing tobacco, by means of which a plurality of tobacco boxes may be filled and pressed, at one and the same time, under the screw, or other power press."

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19. For an improvement in the *Lamp for burning Volatile Oils;* Isaiah Jennings, New York city, N. York, Sept. 11.

Claim.—"What I claim as new, and desire to secure by letters patent, is the employment of two separate reservoirs for the supply of a lamp, or lamps, which reservoirs are to contain volatile ingredients of different natures, and which volatile ingredients are to be conducted into separate chambers in the burner, in which chambers they are to be evaporated, and their vapors are to be made to comingle in a gas, or vapor, chamber, whence it is to escape through suitable holes, for the purpose of being ignited; the respective parts of the apparatus, for effecting this object, being arranged and combined substantially in the manner set forth."

20. For an improvement in the machine for *Felting Fabrics made of Wool, Fur, &c.;* Henry A. Wells, New York city, New York, September 18.

This machine is for felting the fabric still more closely after it has been submitted to the operation of fulling. There is a metallic case, with the inner face convex, attached to the inside and near the bottom of a box. This case is divided, by a partition, into an upper and lower box, the concave portion of the upper one being perforated with small holes, and the ends of both provided with induction and eduction cocks, for admitting and letting out steam. The fabric is acted upon by a hammer, similar to that of a fulling mill, and hung to a pendulous arm, and in addition to this it is also acted upon by a presser, called a "top-piece," so jointed to the pendulous arm of the hammer as to cause both to act together, in compressing the fabric, at the same time that it is under the influence of dry and moist heat, by means of steam introduced in the two boxes; the steam which is introduced in the upper box being discharged on to the fabric through the small perforations in the convex face.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method described of subjecting the material, or bat, to the action of moist and dry heat, in combination with the method, above described, of applying pressure."

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21. For an improvement in the machine for *Hardening Felt Fabrics;* Henry A. Wells, New York city, N. York, Sept. 18.

This machine consists of a hollow metallic bed, the upper face of which is pierced with small holes to permit the steam and dry heat together, or alternately, to pass through and on to the felt fabrics passing over, or lying on it. This hollow bed is provided with suitable cocks to admit the steam, and within it there are horizontal tubes connected together through which heated air, or steam, is passed for the purpose of applying "dry heat" to the fabric. The felt fabric passes over a roller at each end of the machine, and whilst it is under the influence of the "moist, or the dry, heat," or both, it is subjected to the action of a vibratory plate, or platten, to give the necessary friction.

Claim.—"What I claim is the method described of applying to the bat moist and dry heat, in combination with the method described of applying friction."

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22. For an improvement in the *Lamp for burning lard, tallow, and other kinds of fat;* Moses S. Woodward, Marshalton, Chester county, Penna., Sept. 18.

The body of the lamp, which contains the lard, and which receives the burner, is so jointed to a stem, or stand, as to admit of being tilted to any desired extent. By this means the lard can be burned until it is nearly exhausted, for, by the tilting of the body of the lamp, the lard can be brought near to the ignited part of the wick. A metallic

conductor is employed in the usual way, and extends from near the flame to the bottom of the body of the lamp, for the purpose of keeping the lard, &c., in a fluid state.

Claim.—After disclaiming the use of a metallic conductor in a lamp, the patentee says,—"I claim the so constructing of a lamp for burning materials of the kind above named, as to combine with the said method of keeping the materials fluid, the means for tilting the body of the lamp in any required degree, for the purpose and substantially in the manner described."

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23. For an improved *Cooking Stove;* R. P. Putrick, Lockport, Niagara county, N. York, Sept. 18.

The patentee says,—"My stove consists of two principal parts, one of which contains the fire chamber, and two flat horizontal flues which extend therefrom, one of them from the upper, and the other from the lower, side of said fire chamber, said flues being so constructed as to be capable of sliding into flue spaces within the second principal part, in a manner to be presently described. The upper flue is furnished with boiler holes which may be used when the fire chamber is drawn out, or extended, but which are, at other times, embraced within a flue space in the second principal part. The second principal part consists of two ovens, one of them standing above the other, and having flue spaces at their rear sides, and above, below, and between them. The two flat horizontal flues of the fire chamber, slide in and out of the middle and bottom horizontal flue spaces of the second principal part, and when passed entirely within them the stove becomes a two oven stove; but when drawn out it then becomes a three oven stove, requiring nothing more than the applying of two doors, provided for the purpose, to complete the third oven."

Claim.—"What I claim as new, is the combining the two principal parts thereof by causing the two flues to enter and slide within the two flue spaces in such manner as that when said flues are passed into the flue spaces to their whole depth, the stove shall contain two ovens only; and, that when drawn out to the proper extent, said flues shall constitute the upper and lower portions of a third oven, requiring only the application of two doors to render it complete; the respective parts being arranged, combined, and operating substantially as set forth."

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24. For an improvement in *Steering Boats;* Howard Nichols, New Bedford, Bristol county, Mass., Sept. 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of steering boats by passing the oar through a ring of metal, which is connected with the stern of the boat by a double joint, constructed substantially as described, by means of which the oar can be moved vertically and horizontally."

25. For improvements in *Carriage Hubs and Axles;* Henry F. Phillips, Skaneateles, Onandago county, N. York, Sept. 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of a tube, or thimble, of brass, or composition, on the arm of the axletree, so secured that the hub revolves upon it, while it is susceptible of being turned on the axle to shift the bearing part to some other portion of its circumference, as described. I am aware that the tube, or thimble, has been used on the arm of the axletree, but in such cases it has been permanently attached to the axle, and could not be shifted, &c.; therefore, I do not wish to be understood as making a claim to a thimble simply, but confine my claim, as above, to the employment of such a thimble when movable on the arm of the axletree. I also claim the method of retaining the hub on the arm by means of the screw box, in combination with the movable tube, or thimble, as described."

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26. For improvements on the *Combination, or Permutation, Lock;* J. B. Gray, Fredericksburg, Spottsylvania county, Va., Sept. 18.

This is, in the words of the patentee, "for improvements on the combination, or permutation, lock, which is opened and closed by the revolving of a series of rings that are connected together, so as to constitute a cylindrical body, and upon each of which there are numbers, or letters, by the arrangement of which, in a determined order, the opening is effected without the use of a key. Locks of this description are too well known to render a particular description of them necessary; and in my improvement upon them I have not made any changes in their internal structure, but I have so arranged the letters, or figures, and spaces upon the exterior of said lock as to increase the security against its being opened, without the necessity of rendering it more complex, by increasing the number of parts of which it consists."

Claim.—"What I claim as new, and desire to secure by letters patent, is the dividing of the end plates of said lock on their peripheries, into a considerable number of equal parts, coinciding in size with the divisions on the revolving rings, either of which divisions, whether designated by letters, figures, or blank spaces, may be made the starting point in setting the revolving rings. And I likewise claim, in combination with the foregoing, the so constructing the revolving rings as that one portion of them shall require to be set by the spaces intermediate between the letters, figures, or other marks thereon, so as greatly to enhance the difficulty of opening the lock, from the manner of constructing substantially as set forth."

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27. For an improved mode of manufacturing *Figured Damask Hair Seating;* Samuel Ross, Camden, Gloucester county, New Jersey, September 18.

"The nature of my invention," says the patentee, "consists in the introduction of an extra warp of silk, linen, cotton, or woolen, in ad-

dition to the one in general use in the manufacture of figured damask hair seating.

"I claim the invention of producing a satin, or twilled, ground work, at the same time I produce a full satin, or twilled, figure of any color, by the extra warp, which, when combined, produces a full satin, or twilled, face on the fabric."

To be Continued.

ENGLISH PATENTS.

Specification of a Patent granted to JULIUS ADOLPH DETMOLD, *of London, for certain improvements in the construction and arrangement of Furnaces, or Fire Places, applicable to various useful purposes.—Patent dated Oct.* 18, 1843; *Specification enrolled April* 18, 1844.

The principal benefits anticipated from these improvements are, 1. A more intense temperature than is produced in reverberatory furnaces of the ordinary construction; 2. An important saving of fuel; 3. A better yield in the working of metals—or, in other words, a diminished loss of metal from oxidation.

1. Mr. Detmold proposes to make the fire-grate of his furnace much deeper than those in furnaces now in general use, so as to have always a very thick stratum of fuel upon the grate, thereby preventing the passage of any undecomposed air through the grate into the furnace. In ordinary furnaces, the depth of the grate—that is, the distance between the grate-bars and the top of the fire-bridge—is generally from twelve to eighteen inches, and rarely as much as two feet; but in Mr. Detmold's furnaces the depth of the grate is from three to five feet, according as the coal used is more or less bituminous. When a caking, or highly bituminous coal, is to be employed, he makes the grate not less than three feet in depth; for the use of free burning coal, four feet; and for stone-coal, or anthracite, he finds a depth of five feet most advantageous.

2. Instead of relying upon the draught of a high chimney for the combustion of the fuel, he forces the requisite supply of air by means of any ordinary blowing machine, under the grate into the ash-pit, which is closed by an air-tight door. The blast, he says, will cause the imperfect combustion of the "lower stratum of coal immediately upon the grate, and the greater portion of the gases resulting from this will be a combustible gas, namely, the *carbonic oxide gas*, which is invariably produced when the proportion of carbon is in excess to that of oxygen; the portion of *carbonic acid gas*, which is produced, will, in its passage upwards, through the superincumbent mass of ignited coal, absorb an additional dose of carbon, and will, thereby, also become converted into *carbonic oxide gas;* at the same time the carbonaceous gases contained in the fuel, such as carburetted and bi-carburetted hydrogen, will be evolved, or distilled, from the coal by the heat; and thus all the fuel in the fire chamber is converted into

combustible gases, which will pass over the fire bridge into the furnace."

3. The combustion of these gases is effected by forcing amidst them, in their passage over the fire bridge, heated and compressed atmospheric air, supplied in numerous small streams, "thereby causing a rapid and intimate combination of the oxygen of the air with the combustible gases, and, consequently, their immediate and perfect combustion, and a most intense temperature in that part of the furnace where it is required."

The body of fuel in the fire chamber, with the exception of the stratum resting immediately upon the grate, is never at a high temperature, as is the case in ordinary furnaces, but is kept at a low red heat, which is supposed to be quite sufficient to effect the transformation of all the fuel into combustible gases. The supply of blast (cold) under the grate, by which the combustible gases are generated from the fuel, and the supply of hot air for their subsequent combustion is regulated by means of cocks, or valves, which are directed to be so adjusted to each other as to effect the complete combustion of the gases, without having an excess of air in the furnace." "Thus, the effects of the flame in the furnace may be made at will, either reducing, neutralizing, oxidizing, according to the quantity of combustible gases generated, or the volume of hot air admitted for their combustion. The heat thus produced is more directly applied to the purposes required than in ordinary furnaces, in which the heat is produced by the imperfect combustion of the solid fuel in the grate, and where the metal under operation derives its temperature merely from the flame, in its passage through the main, or working, chamber of the furnace; whereas, in my improved furnace, the temperature in the fire chamber, where the combustible gases are generated, is quite low—but their actual combustion, and the intense temperature resulting therefrom, is concentrated in the very spot where the metals are placed for operation, and where the greatest heat is required. The loss of fuel, by the escape of unconsumed combustible gases out of the chimney, is thus avoided; and, as the combustion of the gases in the furnace is effected under a pressure greater than that of the atmosphere without, the loss of metal, by oxidation, in consequence of the air entering into the furnace, through the working door, or through any openings, or crevices, in the furnace, is entirely prevented." Mr. Detmold states, that "any kind of coal may be advantageously used in furnaces of this description; but that they will be found particularly applicable to the use of stone-coal, or anthracite, which has hitherto not been successfully employed for metallurgic purposes in reverberatory furnaces. He adds, that furnaces of this improved construction may be employed with great advantage in the working of all kinds of metals, and that he has himself used them with complete success, for "refining, puddling, and reheating bar-iron, as also for the forging of heavy pieces, such as steamboat shafts."

A furnace constructed on these principles, for refining iron, is represented in the following figures:—

Fig. 1, is a horizontal section, showing the plan of the furnace; fig. 2,

a vertical longitudinal section; and fig. 3, a transverse vertical section, showing the air-heating pipes in the stack.

Fig. 1.

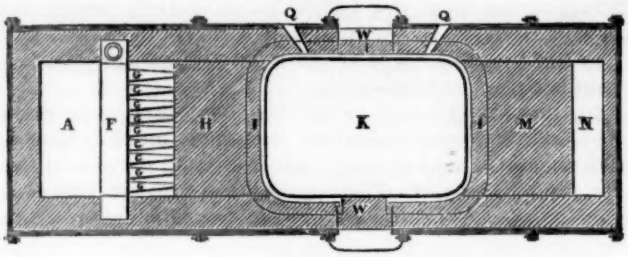
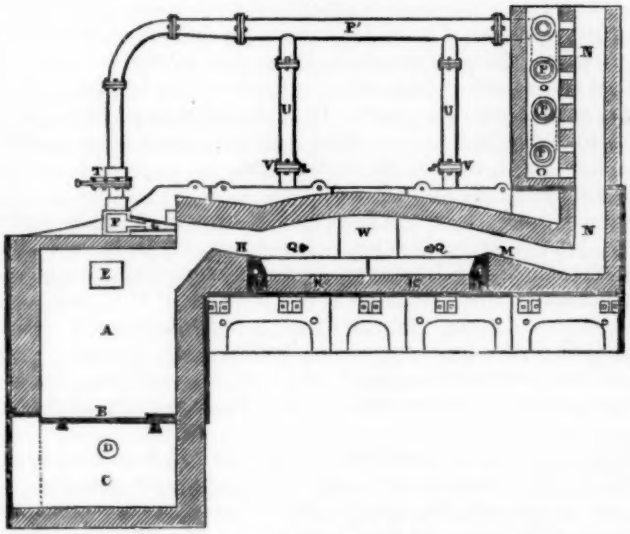


Fig. 2.



A, is the fire chamber, in which the fuel is converted into combustible gases.

B, is the grate, upon which the fuel is supported.

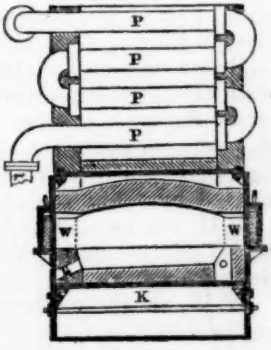
C, is the ash-pit, which is closed in front by an iron door.

D, is an opening in one of the sides of the ash-pit, through which atmospheric air is blown into it.

E, is the stoking hole, for filling the fire chamber with fuel.

F, is the hot air chamber, which is placed on top of the fire, or gas generating, chamber, and from which issue a row of blow-

Fig. 4.



pipes, G, through which the hot air is blown amidst the combustible gases in their passage over the fire bridge. The hot air chamber, F, is of cast-iron, and the blowpipes are of sheet-iron; they are made about fifteen inches long, two inches diameter at the larger end, and one inch and a quarter at the mouth, which should be slightly flattened. In this instance, there are nine blowpipes used; but a greater or less number may be employed.

H, is the fire bridge, over which the combustible gases and the streams of hot air become mingled; it is made much longer than in ordinary furnaces, being two feet six inches from the end of the blowpipes, for the purpose of affording the gas and air time to become thoroughly combined before entering the main chamber of the furnace.

I I, are cast-iron blocks that surround the entire hearth of the furnace, and through which a stream of cold water is made to circulate, for the purpose of protecting the sides from the intense heat, and the destructive effects of the melted iron and scoria.

K K, is the hearth, which may be made of fire bricks set very close on edge, or of good fire sand. It is made to slope towards the tap hole, L, so as to enable the refined iron to run out more easily.

M, is the throat, or flue, of the furnace.

N, is the stack, or chimney.

O, is a chamber, in which is placed a system of pipes for heating the air. This chamber is separated from the stack by a partition of brickwork, which has, however, numerous openings, through which sufficient heat is communicated to the pipes, P P P P, to heat the air which is forced through them to the required temperature. This may be regulated with great nicety, by allowing more or less of the burnt gases to pass into the chamber O, through the openings in the partition, by contracting either the chimney N, or the chamber O, at the top.

Q Q, are tuyeres, through which streams of hot air are blown upon the melted iron, for the purpose of refining and decarbonizing it. They are so placed that their axes converge towards the middle of the hearth, and have a pitch of from 25° to 30°, which will cause the liquid iron to move round in two opposite currents, thereby exposing every part of the surface of the metal to the decarbonizing action of the hot blast.

R, is a pipe leading from the blowing machine that supplies the cold blast, and from which a branch, *r*, goes off, to furnish the blast under the grate into the ash-pit, and which is regulated by the valve S. Another branch, *r'*, rises, and communicates with the pipes, P, in the chamber O, whence the heated air is conveyed by the pipe P', to the hot air chamber F, where its supply is regulated by the valve T.

U U, are two small branch pipes, descending from the pipe P', which convey the hot blast to the tuyeres Q Q, which is regulated by the valves V V.

W W, are the working doors of the furnace, there being one on each side of the furnace.

The mode of refining iron in a furnace of this kind is as follows:—

The fire chamber A, is filled with fuel, and after it is ignited the cold blast is let on under the grate, by which the combustible gases are generated; the valve T, is then gradually opened to admit the hot air for the combustion of the gases. After the furnace has been brought to a white heat, from 25 cwt. to 30 cwt. of pig-iron is charged, and spread all over the hearth, piling it in such manner that the flame may circulate well through. When the charge is melted down quite thin, which will generally be the case in one hour and three-quarters, the hot blast is let on through the tuyeres Q Q, by which the iron will become refined. In about one hour to one hour and a quarter, the metal will be found sufficiently refined, when the furnace is tapped, and the metal runs into the mould.

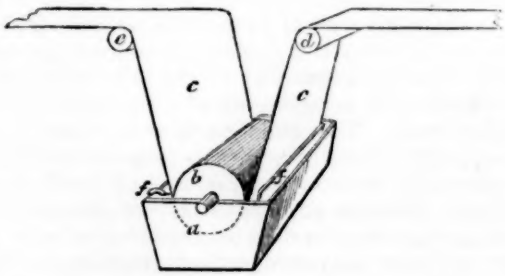
This mode of refining is stated to afford a very important saving of iron over the ordinary method, in the open finery fire. "In the latter, the iron is exposed to the oxidizing action of the blast from the tuyeres, during the whole period of its melting down, so that a very large proportion of the iron is actually converted into cinder before the whole charge is fused. The loss of iron in the open finery varies from 12 and 15 per cent.; but in the operation of refining, in my improved furnace, the whole charge of iron is melted down without any loss from oxidation, as no more air is allowed to enter the furnace than what is required for the combustion of the gases—and the process of decarbonization does not commence until after all the iron is fused; the loss of iron in my furnace is, therefore, much reduced, and rarely exceeds seven per cent., but varying, generally, from five to seven per cent."

Furnaces of this description may, it is said, be also employed with great advantage for the puddling of crude, or pig-iron, by combining the two processes of refining and puddling in the same furnace. "When employed for this purpose, the hearth should be made about eighteen inches wider than that of the refinery furnace just described, which it resembles in all respects except the bottom, which is the same as in ordinary puddling furnaces. The charge is double, being about nine cwt.; and, as the furnace has two working doors opposite to each other, two puddlers work at it at the same time. After the charge is melted down, it is subjected to the streams of hot air from the tuyeres, in the same way as in the refining process; but, instead, of tapping the metal when it is sufficiently refined, the blast from the tuyeres is shut off, and the quantity of gas to be generated is slightly diminished, whereby the temperature of the furnace is reduced to a proper puddling heat. The puddlers then commence to work the iron, the same as in the ordinary furnace, regulating the temperature at will, by generating more or less gas, as may be required. The reheating and mill furnaces, or such as are intended for the forging of heavy pieces, are the same in their arrangement of parts as the refining, or puddling, furnaces just described, varying only in the shape and dimensions of the hearth, according to the nature of the work for which they are intended."

Mechanics' Mag.

***Specification of a Patent granted* Julius Schottlænder, *of the city of London, for certain improvements in the deposition of Metals upon various Felted and other Fabrics —Granted December* 8, 1843; *Enrolled June* 7, 1844.**

The mode of effecting the deposition of metals upon felted and woven fabrics, is as follows:—A plate of copper is, in the first place, to be provided of the required dimensions, one side of which is to be covered with plumbago, and the other rendered inactive by covering it with varnish, or other suitable material, the piece of cloth, or linen, fabric, to be metalized is then to be stretched tightly over that face of the copper-plate which has received the plumbago, and secured by its edges in any convenient manner. The copper plate and piece of fabric to be metalized, are then to be immersed in a solution of sulphate of copper, and the plate connected with the zinc end of the battery; another copper-plate is then to be immersed in the solution, and connected with the copper end of the battery, when the action of the battery will commence, and the metal will be deposited upon the copper-plate between such plate, and the fabric to be coated, and by continuing the operation the metal will begin to penetrate the pores of the cloth, and will appear on the opposite, or back, side of the cloth in small globules. When the operation has been continued a sufficient length of time, the metal plate and cloth may be taken out of the solution, and the metalized cloth removed from the copper-plate, which will be very easily done, and should the plate employed have a smooth surface, the face of the metalized cloth will have a polished surface, but should the copper-plate have an engraved, or embossed, surface, the metalized cloth will also have an embossed surface, and be a fac-simile of such surface, the copper-plate forming the die, or matrix. Ornamental designs may also be produced by drawing upon the copper-plate with some non-conducting substances; or portions of the plate may be cut away; by these means various ornamental designs may be produced, which may be afterwards silvered, gilt, or otherwise finished.



When it is required to metalize a piece of cloth of considerable length, the inventor employs an apparatus consisting of a vessel *a*,

within which is put the sulphate of copper, or other solution; *b*, is a copper roller supported by the ends of the vessel; *a c*, is the piece of cloth to be metalized, and which piece passes over the roller *d*, down and under the copper roller, and up over the roller *e*; *f*, is a copper-plate connected with the copper-pole of a galvanic battery, the copper roller *b*, being connected with the zinc pole of the battery, the parts of the apparatus being connected to the battery by copper wires, and the vessel *a*, filled with the solution of copper, a slow motion being imparted to the roller *b*, the deposition of metal takes place between the cloth and the roller in the manner above described, and should the roller be engraved with some ornamental design, a fac-simile will be obtained. It will be found of great advantage previously to operating upon woven, or felted, fabrics, to wash over the surface of the cloth with clay and water mixed to about the consistency of cream, and then allow it to dry, after which the cloth may be washed with water, which will leave some of the finer particles of clay in the cloth, and will thereby render it more porous and better adapted, in other respects, for the purpose described.

When the surface to be metalized consists of glass, or glazed earthenware, the surface is to be roughened by mechanical, or other means, such as grinding. The parts to be deposited upon are then to be surrounded by a matrix of metal, which is to be connected with the zinc end of the battery, its inner surface being made conducting by means of plumbago. The article to be deposited upon is then to be immersed in the solution, and also a copper-plate, which latter is to be connected with the copper pole of the battery; the metal contained in the solution will then begin to fill up the parts between the matrix and the article to be deposited upon, and by these means any design may be copied and firmly fixed upon the glass, or glazed surface of earthenware.

Civ. Eng. & Arch. Journ.

MECHANICS, PHYSICS, AND CHEMISTRY.

Extracts from the Report of Capt. G. W. HUGHES, *of the Topographical Engineers, to the Secretary of War, relative to the working of Copper Ore.*

(Continued from page 202.)

On the Cornish Engines.—The pumping engines used for draining the mines of Cornwall,* have lately excited much interest in the scientific world, from the circumstance of their performing with a given quantity of fuel, nearly three times as much work, or, as it is technically termed, *duty*, as any other engines have yet been made to accomplish; and, therefore, a slight notice of them, and of the history of their improvement, may not prove uninstructive.

* Engines have been very recently constructed on the same principles for the drainings of the Lake of Hærlem, with cylinders of 12 feet diameter.

The common Bolton and Watt single acting engine, used for pumping water, which was formerly applied to these mines by Watt himself, is so well known, and has been so often described, that it will be sufficient merely to point out the differences which exist between this and the Cornish engine, in its present most improved state.

The first and most important is, that the steam is used at a high pressure—say from thirty to forty-five pounds per square inch above the atmosphere—in the boilers; is cut off at a small portion of the stroke, and allowed to expand during the remainder. The principle of expansion was introduced and patented by Watt, but was used by him only to a very small extent, and with low pressure steam. It is now carried much further, and the steam is generally expanded from four to eight, or ten, times its original volume, and, in some of the more recently constructed engines, much more. The new engine at the United Mines, which was kindly shown and explained to Mr. Pole and myself by Messrs. Hocking and Loam, the engineers, has been sometimes working with the steam cut off at one-twelfth, or one-fifteenth, of the stroke; and Mr. Sims, another engineer of celebrity in the county, has lately taken a patent for a mode of increasing still further, the power of using the steam expansively. This forms, indeed, the great feature of the Cornish engines, and is, without doubt, the principal cause of the extraordinary amount of duty performed by them.

The use of high pressure steam has necessarily induced a change in the form of *boiler*, from that originally adopted by Watt. The boilers now used are cylindrical, with an internal tube of large diameter running through them, in the front part of which is placed the furnace. The *slow* combustion principle is carried to a greater extent in Cornwall than elsewhere, and it is the generally received opinion there, that much advantage arises from the practice. Doubts have, however, been lately thrown upon the correctness of this idea, by the publication of some experiments made within these last few years at the London water-works, of which I shall more particularly speak hereafter.

The care which is taken to economize heat, and prevent waste of fuel is exceedingly great. The tops of the boilers are covered with a bed of ashes about two feet in depth; the cylinder is inclosed in a steam jacket, and this again is surrounded by a wooden case, having a considerable thickness of saw-dust between it and the hot metal. The steam pipes are encased in like manner, so that the radiation of heat is almost entirely prevented, and, in consequence, the engine and boiler houses are little, if any, warmer than common rooms. The condensed water from the steam jacket is also returned to the boilers; the steam is prevented from ever blowing off at the safety valve, by careful management of the fires; and, in short, every precaution that ingenuity can devise, or prudence suggest, is taken, in order to reduce to its lowest possible limit the dispersion of heat, and consequent waste of fuel.

The arrangement of the pumps and their machinery has been greatly improved since the days of Watt, and no inconsiderable share

of the improvements in *duty*, is attributable to this cause. The description of pumps universally employed now, (except in the lowest part of the well, where a lift pump is placed,) is the *plunger pump*; three or four of these, according to the depth, being placed at different levels in the shaft.* The rods which connect the plungers with the outer end of the engine beam are necessarily, from their length, of great weight; and it is this weight, or, at least, a portion of it, which causes the plungers to descend, thereby forcing up the water in the ascension pipes. The mass of rods is raised by the action of the steam in the descent of the piston; and when this has arrived at the bottom of its course, and by the opening of a valve, the equilibrium is restored between the upper and lower parts of the cylinder, the rods again raise the water by descending, and are afterwards again raised by the steam in their turn, so that the power of the steam is not immediately employed to raise the water, but lifts a dead weight, which, in its descent, forces down the plungers. The pump rods generally furnish more weight than is sufficient to overcome the pressure of the column of water in the ascension pipes, and the surplus is counterbalanced by weights attached to levers, or "balance bobs," placed at the surface, or in horizontal excavations in the shaft. There are many minor improvements which have been made in the valves, and other details of the engine, as well as in the method of managing and working it; all of which have conduced more or less to the advancement of the duty performed, but which our limits will not permit me to describe. They do not, indeed, affect the general principles upon which the engine works; and enough has been said to show that this, by far the most perfect and effective form of an invention, itself the most perfect and useful to mankind of any yet recorded in the page of history—that this is, to all intents and purposes, WATT'S ENGINE; and that it has only been by carrying out, to a further extent, the principles laid down and first put in practice by that great man, that the extraordinary achievements now witnessed have been accomplished. And, in fact, one of the most eminent of the Cornish mining engineers has said, in speaking of the modern pumping engines, that "the engine is now reduced to its simplest form, a single engine on Bolton & Watt's construction; and, although our engines exceed in duty three or four fold what Bolton & Watt had ever attained, or perhaps thought possible of attainment, yet they are, after all, in name and reality, Bolton & Watt's engines." It would be, however, an act of gross injustice to the Cornish engineers to pass by unnoticed the improvements in the performance of the steam engine, due to their mechanical skill, and scientific knowledge; and, indeed, if their merit be measured by the advantages which have resulted from their efforts, they, as a body, will deserve most memorable mention in the annals of the steam engine.

I shall now proceed to present a brief view of the history of the various improvements in duty which have gradually taken place for the last half century, the materials for this purpose being supplied by a very succinct account compiled by the Messrs. Lean, brothers, and

* All these fittings, including the "balance bobs," constitute what is called the "pit-work."

published by direction of the British Association for the Advancement of Science. To this work I refer for more detailed information.

It will be as well to explain that the word "*duty*" may be defined to mean the useful effect produced by the engine, considered in proportion to the quantity of fuel consumed. In Cornwall, the *duty* is always stated in *pounds lifted one foot high* by the consumption of one bushel (about 94 pounds) of coal. Thus, when it is said that a certain engine performs a duty of seventy millions, it is understood to mean that the engine lifts seventy millions of pounds of water one foot high for each bushel of coal consumed.

The connexion of WATT with the Cornish miners, who paid him for his great improvements by a per centage upon the value of the fuel saved by them, is well known, and is mentioned in almost every history of the steam engine. It may be sufficient to state here that he raised the duty from about nine millions, as previously performed by the atmospheric engine improved by Smeaton, to upwards of twenty millions; and the average duty in eighteen hundred, when the patent of Messrs. Bolton & Watt expired, and their agent left the country, may be stated at this amount. After this period a great and general deterioration took place, from the want of persons of sufficient experience and scientific acquirements to keep the engines in the same good state, and to work them to the same advantage, as formerly.

This state of things lasted for many years, until, in 1810, or 1811, the practice of publishing monthly reports of the duty of all the engines in the country was commenced by Capt. John Lean, and has continued uninterruptedly to the present time. This publication produced a very extraordinary effect in improving the duty of the engines. The public attention being drawn to the amount performed by each, stimulated the engineers to emulation among themselves, so that many engines, before much inferior, began to improve in duty when the results were published to the world; and the practice is said, by Messrs. Lean, to have been attended with more benefit to the country than any other single event, with the exception of the invention of the steam engine itself. Its effects were soon manifest, for, in 1814, one engine performed thirty-two millions, and the average of the county was raised again to where Watt left it—namely, twenty millions.

In the latter part of 1814, Woolf demonstrated the possibility of increasing the duty by using high pressure steam, and expanding it more than hitherto practiced, which he did by his double cylinder engine. One of these, erected at Wheal Vor, in 1815, performed fifty millions. It was not long, however, before it was discovered that this principle of using high pressure steam expansively might be used equally well with a single cylinder; and, after 1820, the more cumbrous and expensive form of Woolf was very little used in the mines. In 1821, the average duty was twenty-eight millions, and that of the best engine forty-two.

Shortly after this period, Capt. Samuel Grose introduced various improvements at Wheal Towan, and performed sixty-two millions. The principles adopted by him were followed, with modifications, by

other engineers, and their advantage was rendered obvious by an immediate advance in duty of the whole.

In 1834, a very important occurrence took place; Mr. Wm. West, who had formerly filled a situation under Capt. Grose, constructed an engine at Fowey Consols mine, which, in September of that year, was reported at a duty of 97,856,382. Such an extraordinary and unprecedented amount created great astonishment among the engineers of other mines. Suspicions were entertained that some deception must have been practiced, and Mr. Austen, the proprietor of the mine, was called upon to verify, or disprove, the statement, by allowing a trial to be made of the engine before competent and impartial persons. He responded to the call; and seven gentlemen were named by J. S. Enys, Esq., of Enys, for the purpose. They made a most accurate experiment of twenty-four hours' duration, and reported the duty performed to be equal to 125,095,713 pounds lifted one foot high by the consumption of a single bushel of coal! This is, I believe, the highest amount of duty which has ever been obtained. Up to the present time, the general average has been steadily improving, and many engines are now working at ninety millions and upwards. The one at the United mines, lately erected by Messrs. Hocking & Loan, was reported, in the month of July, 1841, at 101,500,000. It is one of the largest in the country.*

When it is considered that the useful effect of the best land, or marine, engines now made, when reduced to the same standard as that used for the Cornish engines, gives a result rarely exceeding thirty millions, it need not be wondered at, that the engines in that country must have excited great interest among engineers throughout the world. But although for such a length of time these improvements have been going on in the manner above described, it is only very lately that the general attention of men of science in other localities has been drawn to the very extraordinary results produced by them; and when the reports were first brought forward in London, they were almost unanimously treated as fabulous—many of the most eminent scientific engineers expressing the opinion, and, in some instances, sustaining their opinions by calculations, that it was absolutely impossible that steam could be made to perform feats so wonderful, and so much surpassing what had before been experienced. As, however, the statements and guarantees of their correctness be-

* The following are the principal dimensions and other particulars of the new engine at the "United Mines," called "Taylor's Engine:"—

Cylinder, 85 inches diameter.
Length of stroke of piston, 11 feet.
Length of stroke of pumps, 10 feet
Diameter of principal working plungers, 14 inches.
Depth of shaft, about 173 fathoms.
Number of strokes per minute, about 4½.
Water lifted, about 60 gallons per minute.
Weight of main beam, 27 tons.
Cylindrical boilers, each about 25 feet long, and 6 feet 6 inches in diameter.
Cost of engine, £2,500.
Cost of pumps, &c., £5,000.
Cost of shaft sinking, £8,000.

came stronger and more numerous, scientific men began to look more closely into the matter. Some eminent engineers went down to Cornwall, from London, purposely to convince themselves of the truth, or falsehood, of the reports. The most searching experiments were tried—the water was, in some instances, even weighed as it came out of the pumps; but nothing was found to cast the shadow of a doubt upon the correctness of the reports; and now the evidence has become sufficiently strong to command universal assent.

But more than the evidence of witnesses at a distance has been obtained, for, in order to put beyond a doubt the truth of the assertions as to the amount of duty performed, one of the Cornish engines has, so to speak, been actually transplanted to London, and tried there; and a most interesting record of experiments upon it has been recently published by Mr. Wicksteed, the engineer of the works where it has been erected and used for supplying water to the metropolis. The following extract will explain the circumstances under which it was introduced:—"In the spring of 1835, the directors of the East London Water-Works Company, contemplated making very considerable alterations in one of their engines at Old Ford; and it was then suggested by Mr. Grout, one of the directors, that instead of altering the engine in question, it should be taken down, and a Cornish engine erected in its place; and he stated that the saving in fuel, that would be effected by adopting his suggestion, would amply repay the company for the increased outlay consequent upon the erection of a new engine.

"I am told that but little reliance was placed upon the accuracy of this information; my opinion was, however, called for, when I stated, that although I had never seen a Cornish engine at work, I understood the principle of its action, which my friend, Mr. John Taylor, had explained to me as far back as 1826; and I was also aware of the favorable views entertained by the late Mr. Watt, of the advantages to be derived from using steam expansively, and had, therefore, no doubt that the effect produced by the Cornish expansion engines was much greater than that produced by the non-expansion engines.

"In August, 1835, I was instructed to visit several of the mines in Cornwall, for the purpose of obtaining information respecting the engines in use there; and although my report was highly in favor of them, the opinions expressed in favor of the *old* system, and against the *new*, advocated by me, were nevertheless so numerous, and of such high authority, that it was not until two years afterwards, in 1837, (upon Mr. Grout's information, that a good second hand engine was to be disposed of at a comparatively low price,) that I was instructed to proceed to Cornwall for the purpose of purchasing it. The engine, which was a counterpart of the one at 'Fowey Consols' mine, already mentioned, was accordingly erected at the East London Water-Works, and was started in December, 1838. It worked very satisfactorily, and performed a duty of upwards of ninety millions."

Mr. Wicksteed has made a long series of experiments upon the engine during three years, and the work above mentioned contains the results he has arrived at, which may be briefly stated as follows:

1st. That little or no difference is perceptible between the results of slow and quick combustion; that the Cornish cylindrical boilers and method of working do not evaporate a greater quantity of water for the same quantity of fuel consumed than the old wagon-head boilers, ordinarily used for low pressure steam; and that "it would, therefore, appear that very little, if any, improvement has been made in the evaporative power of boilers since the days of the great, the immortal James Watt."

2d. That the duty of the Cornish engine experimented upon, is, for the same quantity of coals consumed, in the ratio of about two and a quarter to one to that of a Bolton and Watt engine upon the common construction, at the same works, with which it has been carefully compared.

Mr. Wicksteed gives a list of the causes to which he attributes this greater duty, and several elaborate tables accompany the work, forming altogether the most valuable collection of facts upon the subject which has yet appeared. The example of Mr. Wicksteed has been followed by other engineers, and engines of the same construction are now in course of erection for water-works in the neighborhood of London.

The paper alluded to merely gives the facts and results obtained by the experiments, but does not profess to go into the subject of their correspondence with theory; there exists, indeed, no sufficiently accurate theoretical investigation of the circumstances attending the action of the Cornish engine. It has been mentioned incidentally, in works upon the steam engine, particularly in the excellent one published a few years since by the Count de Pambour, but with not so much attention to the minutiæ of the case as its peculiarity and importance would seem to demand. Some opinions have been expressed, and that, too, by parties of considerable practical experience, that the simple elastic force of the steam in these engines is insufficient to perform the work done, and that the deficiency is supplied by the effect of the *momentum* of the steam in entering the cylinder, and its consequent "*percussion*," as it is termed, upon the piston; but neither the deficiency of the one force, nor the existence, to any thing like an appreciable extent, of the other, has been proved by data of sufficient authority, or calculations sufficiently accurate, to warrant the adoption of these opinions, and they have consequently not been favorably received. It is, however, to be hoped that the general interest excited among engineers will induce some one, possessing the requisite ability and opportunity to combine theoretical investigation with practical observation, to turn his attention to the subject, and investigate it in such a manner as to satisfactorily account for and explain, upon exact mathematical principles, the circumstances of the case, and the causes of the superiority in point of economy of these engines; for by such a process alone may we expect to see any sufficient means proposed and adopted for introducing into steam engines generally the improvements, and realizing the advantages possessed by the Cornish ones. I have the honor to be, Colonel, your obedient servant,

GEORGE W. HUGHES, Capt. Corps Top. Eng., U.S.A.

Col. J. J. Abert, Chief Corps Top. Eng.

Pump Valves.—From the Minutes of the Proceedings of the Institution of Civil Engineers.

Mr. J. B. Jordan exhibited and described a model, showing the principal pump valves, used by mining engineers. Mr. Jordan stated, that the model before the meeting, was intended to illustrate mining machinery, and was one of a series, now in progress of construction for the Museum of Economic Geology. There were eight differently constructed valves in it, each surmounted by a glass valve-chamber and pipe; the large central pump, served to circulate the water through all the valves simultaneously, so as to show their comparative action; the water was then discharged from the collar launders over each valve, into that at the head of the pump, so that by repetitions of the pump-stroke, the circulation through the valves might be kept up at pleasure.

The valves shown in the model might be divided into four classes: 1st, those in which no attempt was made to counteract, or avoid, the violence of the beat, or concussion, on closing the valve; 2nd, those in which that evil was reduced, by dividing the horizontal area of the valve, into several parts; 3rd, those in which the same object was attained, by reducing the horizontal area of the moving parts of the valve; 4th, that in which the concussion was reduced to any desired amount, by making one side, or portion, of the column, to a certain degree, balance the other.

Valves of the first class were so well known, that they required little description; they were the common pump clack, moving on a leather joint, and having, generally, a very small water-way—the improved metal joint clack, in which the water-way was much increased—and the "button clack," or, as it was called in Cornwall, "heantlebury's clack," which was a disk of metal with a central spill, or stalk, which rose and fell in a guide. Of these valves, the second was considered the best, inasmuch as it had the largest water-way, (some portion of which was direct) and it was free from some minor objections, to which the leather-jointed clack was liable. This valve was, therefore, in very common use in mine pumps, where the area of the pump, and the height of the column, were not such as to produce any serious inconvenience from concussion, in closing the valve.

In the second class of valves, the injurious effect of a violent beat was somewhat avoided, by the ingenious expedient of dividing the valve into several rings, or segments. The simplest of this class, was the well known "butterfly valve," in which two semi-circular parts opened on a central hinge of leather, and the beat was divided into two parts; but as those closed at the same time, the concussion was principally reduced by the fall not being so great. The next valve was composed of several triangular pieces, opening on leather joints, from the circumference of the valve seating; it had been much used by Captain Reed, of the Mold Mines, Flintshire, and was reported of favorably, by several other mining engineers. It closed with a very

slight concussion, on account of the arc of each part being small, the base of each triangle forming the joint, while the water-way was large, and nearly all direct, admitting the mass of water to pass forward, in line parallel to the side of the pump. In the other valves of this class, no leather was used, a circumstance which rendered them more applicable to large pumps, where continuous working was of the utmost importance, particularly in the case of deep mines.

Fig. 1.

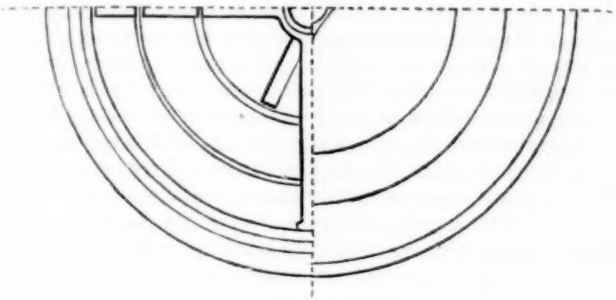
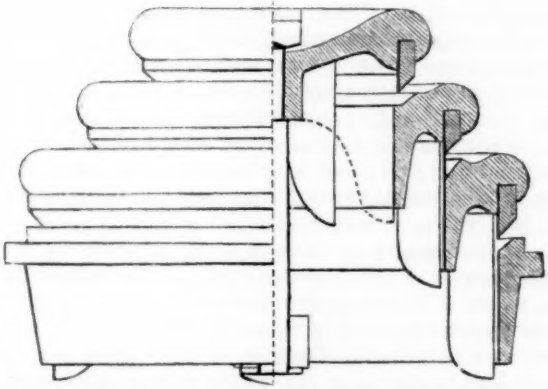


Fig. 2.



The two annular valves shown, were invented by Mr. Hosking, of the Perran Foundry, and Mr. Jenkyn, of the Copper-house Foundry, (Cornwall.) The first of these was composed of a series of rings working on a vertical spill, each ring having its seat on the one beneath it, (see figs. 1 and 2;) these rings have different areas, and fall in succession through a small space, compared with that which would be requisite, if the valve were in one piece, so that the concussion was much reduced, while the water-way was increased; but the latter being all lateral, it was requisite to have a large valve-chamber. The beats of this valve were formed of tin. Mr. Jenkyn's valve differed in construction from the one just described, in having the rings connected with each other by shackle-joints, instead of their working on a vertical spill; the mode of forming the beat was also

peculiar; it was composed of two thicknesses of leather, between which wedges of wood were driven into a groove, cast for their reception in the rings; these materials were so placed, that the edges of the leather, and the end grain of the wood, might form the striking surface of the beat, after being turned off in the lathe.

In the third class of valves, which avoided concussion by reducing the horizontal area of the moving parts, were Messrs. Harvey and West's, and Mr. Hosking's double-beat, and Mr. Darlington's cylindrical single-beat valves. The first of these was a modification of the double-beat steam valve, so long used in the Cornish engines; the second named was similar in principle, and was only slightly different in construction. They were both good valves, each giving large lateral water-ways, and, therefore, they required valve-chambers of corresponding size, to ensure their perfect action. Mr. Darlington's cylindrical single-beat valve, was contrived for a large set of pumps under his management, at the Alport Mines, (Derbyshire.) The rising column of this pump was 38 inches in diameter, and 22 fathoms in height; it was, therefore, desirable, in such a pump, to reduce the concussion as much as was consistent with the power of closing the valve in proper time; this was accomplished by causing a cylinder to rise over a metal ring packing in the seating of the valve, so much as to give a large lateral water-way under the beat, formed by the bottom of the cylinder. This valve was found to act well, but it required a very large chamber for the water to enter; the reason for adopting one, instead of two beats, was to avoid, or lessen, the leakage, caused by chips getting between either of the beats.

The only valve belonging to the fourth class, was that of Messrs. Palmer and Perkins; it consisted of an elliptical disk, moving on an axis placed parallel with, and near to, the minor axis of the ellipse, and closing at a considerable angle, against the interior surface of a cylinder. In a valve, so constructed, it would be readily perceived, that the concussion might be reduced to any extent, by bringing the working axis nearer to the geometric axis of the ellipse, because the force, with which it closed, must depend on the difference of area between the upper and lower portions of the disk. It possessed an advantage in the extent and character of its water-way, over all the other valves described, nearly the whole of the water-passage being parallel to the side of the pump. On the other hand, it was objected, that the axis would be liable to rapid abrasion, and, consequently, the valve would become leaky; but Mr. Jordan did not concur in the opinion of that being an insurmountable difficulty, and he hoped that the valve would be tried, under circumstances which would put its merits to a severe test.

Remarks.—Mr. Taylor said, that the subject of valves for pumps, had been so ably treated by Mr. Homersham, in his paper, which was read before the Institution last session, and, in the discussion upon it, that there remained but little for him to say. He could not, however, allow the model, which had been exhibited by the permission of Sir Henry De la Bêche, to pass without a few remarks.

In Cornwall, after the improvements in steam engines had made

considerable progress, attention was directed to the more perfect construction of the pumps. The plunger was introduced about that period, and the merit of it has been claimed by different parties;* its use was attended with many advantages, and had now become almost universal. Some of the benefits derived from its substitution, for the common piston, or bucket, had no reference to the subject of valves, and, therefore, need not be mentioned. In one point it was of great importance, for as the size of the water-way of the valves in the bucket was necessarily limited by the diameter of the working barrel, an arrangement like that of the plunger pump, which permitted both valves to be fixed in seatings, of which the areas might be increased to any convenient extent, became the more desirable; it was, therefore, extraordinary that such tardiness had been exhibited in taking advantage of such an obvious improvement, when the principle had been long known, and the loss of power, consequent on the former system, was admitted. The model which had been explained by Mr. Jordan, showed how much the attention of engineers had now been directed to the subject. In the discussion of Mr. Homersham's paper, Mr. Taylor had mentioned the advantage which had resulted from the extension of the water-way of some large pump-work, by having two suction-pipes, or wind-bores, and thus doubling the passage through the valves. It appeared important, for all the valves that discharged the water laterally, that more space should be provided round the seatings in which they were placed, and for want of that precaution, some excellent valves had not answered so well as they would otherwise have done. That which was invented by Mr. Darlington, to avoid some inconveniences in the use of the double-beat valves, would have been improved by an enlarged space around it. As mines increased in depth, and the volume of water became larger; as steam engines came into use, having a rapid and sudden motion, as compared with that of water-wheels, which were formerly universally employed for pumping, a great inconvenience was felt, from the concussion in the columns of the pumps; this was occasioned by the beating of the valves upon their seats, and in pumps, of the diameter needful for draining some of the mines, this evil became very serious. Almost all the improvements in valves were made with that view; the division of the old butterfly valve into segments, was an obvious first step; it had succeeded extremely well, and was still not much excelled. The annular valves of Hosking, Jenkyn, Simpson,† and others, were based on the admitted principle of dividing the falling clacks into several parts, that they should not rise so high, and that they might collapse in succession, and thus avoid concussion. Harvey and West's double-beat valve partook of that principle, but was stated to have the advantage of presenting a small area to be acted upon by the pressure of the column of water upon it. Darlington's valve, which was contrived to avoid the inconvenience

* The plunger was used by Sir S. Morland, in 1683, for the force pumps at the Machine de Marly.

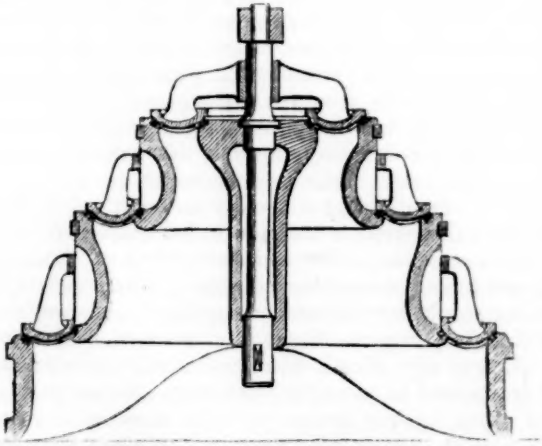
† The annexed engraving of a treble ring valve, fig. 3, is a section of Mr. Simpson's valve described by Mr. Homersham, in his paper of last session before referred to. It is a coni-

arising from the leakage, from both the seats of Harvey and West's valve, when any substance obstructed its perfect closing, presented also a small area for the pressure to act upon; but as it discharged the water laterally, it required an increased space around the seating.

The model exhibited a valve, introduced by Messrs. Palmer and Perkins, upon a principle, by which concussion might be considerably reduced, by bringing into action a part of the superincumbent pressure, to check the descent in closing the orifice. This valve had not yet been tried in large pumps; but the opinion of practical men appeared to be in its favor.* In the construction of all valves, it was of importance, not only to attend to the points which had been mentioned, but also to their durability, and their facility of removal and repair. The actual cost of the valves was of little importance, when compared with the labor and hindrance in removing, or cleaning, them, where the influx of water was great. Serious expense, and loss of time, were frequently occasioned by such stoppages, and the deeper parts of the mines were exposed to obstructions, which were overcome with great difficulty, notwithstanding many ingenious and well arranged contrivances, to render the process of repair easy and expeditious. Very powerful capstans, and other means were pro-

cal valve formed of rings, shutting down upon separate seatings, allowing a passage for the water both inside and outside the rings. Valves of this construction have been introduced at the Lambeth and Chelsea water-works. The valve at the Lambeth works is 30 inches in diameter, the perpendicular rise, or lift, when fully open, does not exceed 1¼ inches. The clear, uninterrupted area through which the water passes, is more than two-thirds of the whole area of the valve, the internal diameter of the seating being 27 inches. The valve at the Chelsea works is 43½ inches diameter, and the greatest height to which the rings of the valve rise, does not exceed 2¼ inches.

Fig. 3.



* A valve of a very similar construction is described in Belidor's "Architecture Hydralique," vol. iii, p. 221, as having been introduced by him in 1737, for the improvement of the water-works at the Pont Notre Dame, Paris. The situation of the pivot of the valve, is described to be at one-twelfth part beyond the line of the geometrical diameter of the pump barrel.

vided for these emergencies, and as the labor of fifty, or sixty, men was sometimes required to work these machines, it would be easily conceived how important it was, that such operations should occur as seldom as possible, and that the most perfect and durable construction should be aimed at.

Mr. Perkins observed, that although, at the first view, a certain degree of resemblance might appear to exist between Belidor's valve, and the disk valve of Palmer and Perkins, there existed, in reality, but little similarity between them. The former was placed horizontally, whether used as a clack, or as a bucket; in all cases it required to be adjusted to a seating formed of reversed cones, like the ring of a steam throttle valve, and it was always attached to a packed bucket, or piston. Whereas, the latter worked at an inclination of about 4th of the diameter of the pump; it was adjusted within the bored pipe without any seating, and it formed a piston without any packing. Its form being that of an oblique section of a solid cylinder, whose diameter was equal to the interior of the working barrel, and the line of its suspension being beyond the diameter, the areas of the two portions of its surface were unequal; consequently, there was more pressure on one side of the line of suspension than on the other. By this extra amount of pressure, the disk was turned on its axis, allowing a free passage for the water parallel with the sides of the pump. The closing of the lower valve on the return stroke, was, for this reason, without noise, or concussion. It was evident, also, that as packing was not necessary for the disk piston, and as the rubbing surface of its periphery was very small, the friction must be greatly diminished. Messrs. Bramah and Robinson made an experiment for comparing a pump, with a packed bucket and butterfly valves, with one having a disk piston; the diameter of both pumps was 10 inches, with a stroke of 8 inches, a lever of six to one, and a lift of water of 5 feet; it was found that the former required a force equal to 460 lbs., and the latter 196 lbs. to complete a stroke. As regarded their duration, a disk pump 7 inches diameter, with a stroke of 8 inches, and a lift of 40 feet, drawing its water through 600 feet of suction pipe, rising, in that length, 28 feet vertically, and worked by a steam engine 26 strokes per minute, had been found, after working nearly night and day, at the Equitable Gas Works, during fifteen months, without repair, to exhibit but little appearance of wear in the piston, and both it, and the clack valve, were perfectly tight. As the subject appeared to interest the Institution, he promised to present, on a future occasion, a more detailed account of some similar pumps, with the actual results obtained.

Mr. Lowe corroborated the statement of the efficiency and duration of the valve used at the Equitable Gas Works; its friction was necessarily very small, for as it formed, at the same time, both piston and valve, and in the return stroke, from its nearly vertical position in the working barrel, the parts in contact were reduced to the area of the points of the minor axis of the disk, the friction was in proportion to that area. As a seat valve, he thought it less liable to become defective than any other, as it was scarcely possible for any sand, or other

foreign matter, to lodge upon it, and the valves which he had seen at work did not show any symptoms of being so affected.

Mr. Farey said, that it was an axiom relative to steam engines, that their action became more perfect as their size increased, but that this could not apply correctly to pump valves; for, as their size had augmented, the difficulties in their construction had been more fully developed. With small valves it had been considered, that the vertical height of the lift of a clack should be one-fourth of the diameter of the barrel, but it was evident that rule could not be adhered to with large valves. Other forms, allowing a free passage for the water, had, therefore, been resorted to, and with great success, but there was still room for improvement. He had a high opinion of the valve which had been used originally by Messrs. Boulton and Watt, and which was called, from its form, the "Bishop's cap." It consisted of four triangular flaps of leather, hinged on the periphery of the valve, and meeting in the centre; the number of these flaps had been, he believed, increased to six and eight for very large sizes, and they afforded a very free passage for the water. Much yet remained to be done in improving the valves of the air-pumps of steam engines, especially in adapting them to the speed of the engine, so as to avoid the loss of power consequent on drawing, or forcing, the water through contracted passages.

Mr. Jordan was happy to find his opinion of the disk valve corroborated. He had viewed it almost entirely as a clack valve, on which the whole weight of the column of water would rest, and for that purpose he thought it particularly suited. He could not agree in the opinion that chips of wood, or other substances, would be liable to accumulate near the axis, and render it leaky. He thought, on the contrary, that it would clear itself very easily, and as the faces, or seats, were vertical, it was not possible for any thing to rest upon them. It had been urged, that these valves were difficult of construction, and would scarcely be found tight under a very heavy column. He conceived, however, that with modern machinery, there could not be any trouble in making them perfectly accurate, and that the simple addition of a beard of leather, fixed on the upper side of the longer portion of the valve, and to the seating at the shorter part, would render the valves quite tight.

Mr. Homersham observed, that any particular form and proportion of a valve, which enabled it to answer well in one situation, was no criterion of its doing the same under other circumstances; for instance, the suction and delivery valves of the pump of a Cornish mine engine, required to be differently proportioned, as, in order to follow the speed of the plunger, the water was obliged to move through the former more rapidly than through the latter; for the velocity of the down stroke of the steam piston of a Cornish engine, was chiefly regulated by the portion of the stroke at which the steam was cut off, whereas its velocity in going out was most usually adjusted by varying the period of the pause at the end of the stroke; although it was also somewhat governed by the number of strokes per minute which were required to be made. Therefore, as the plunger always

moved quicker in the former, than in the latter case, the velocity of the passage of the water through the suction valve (unless its area were increased,) was greater than through the delivery valve, and the moving part of the valve, against which the water impinged, required to be heavier in the former than in the latter, to insure its closing before the return stroke of the engine commenced. This had been pointed out in his paper on valves, which was read in the last session, and a rule was given* for their relative weights, which should always be in proportion to the velocity of the water passing through them; if this were not attended to, and they were both made of the same weight, the delivery valve would not open freely, and thus more weight would be required to carry the engine "outside," and the duty would be diminished. He was, therefore, of opinion, that every valve required to be adjusted expressly for the situation in which it was placed, and the duty it was required to perform.

Mr. Galloway drew the attention of the meeting to a pump which was introduced by Mr. Jacob Perkins, in 1820,† and was rewarded by the Society of Arts. The barrel consisted of four boards, nailed together, so that its horizontal section formed a square. The bucket rod was enlarged to a broad end, intersecting the square diagonally; to this two valves were affixed by leathern hinges. Their form was that of an isosceles triangle, the base of each being united to the rod, and the other sides resting, in an inclined position, against the inner sides of the barrel, filling the entire area. In the down stroke of the bucket, this form offered little opposition to the water, and was sufficiently tight for common purposes, with but little friction. Mr. Galloway subsequently constructed a pump with a wooden barrel, in which the valve was in one piece; the preponderating action, like that of the oval disk pump, was effected by giving the barrel the form of a trapezium, the valve being suspended by an axis, which crossed it at the bases of the two unequal parts. Neither the trapezium valve, nor that of Jacob Perkins, were, he conceived, generally applicable; their utility would not extend beyond domestic purposes, or those countries where the means of boring cylindrical barrels were not attainable. Mr. Galloway was of opinion, that the principal objections to the elliptical disk valve were, first, that as the axis of the valve did not coincide with the minor axis of the ellipse, the spindle would either bend, on the valve being raised to a vertical position, or it would not fit the cylinder when it was shut; secondly, that there was no compensation for abrasion across the minor axis, so that when the valve was worn, either by the friction of sand, or from other causes, it would become leaky. Mr. Galloway then exhibited a form

* The following is the rule referred to by Mr. Homersham: "The mean velocity of the water in feet per second through the valve being ascertained, one half more is added, and considered as the maximum velocity of the water through the valve, and the height of the head of water being found that would produce the velocity, every $1\frac{3}{4}$ inches of such height is then considered as equal to an ounce weight avoirdupoise acting upon every square inch contained in the area of the valve, against which the water impinged in its passage to the pump barrel, allowance being made for the difference of the weight of the ring when immersed in water; compared with its weight in the air."

† Vide "Transactions of the Society of Arts," 1820, vol. xxxviii, p. 106.

of valve, by which he submitted these objections would be obviated. If an ellipse was intersected diagonally, at an angle of 45° with the major and minor axes, and one portion was turned over, so as to produce a heart-shaped figure, when joined to the other portion by a hinge, it was obvious that these two leaves, when placed in a cylinder, would fill the cavity as the original ellipse had done; both the minor and major axes being at different angles. These leaves being supported from beneath by rods with ball and socket joints, the wear in any direction, would be compensated by the extension of the leaves, as their constant tendency was to become horizontal. The rocking rods, acting at points on the leaves, where the preponderance of surface was in one direction, enabled the water to open and close them, with that easy motion which was so much desired in heavy lifts.

Mr. Jordan wished it particularly to be understood, that he had directed attention to the disk valve, hoping that from its simplicity of action, it might be tried and found serviceable, for the clacks of deep mine pumps, of large diameter, and working under a column of from 10 to 50 fathoms in height. There was little doubt of the valve being tight under ordinary circumstances, and with short lifts, but when a heavy column of water was allowed to rest upon a valve, the slightest inaccuracy was detected.

Mr. Homersham differed in opinion with Mr. Jordan, as to the applicability of the disk valves to deep mine-pumps. He conceived there would be a certain amount of difficulty in constructing them so as to be perfectly tight under a heavy column of water, and the spindle or pivot of the valve would require to be of large diameter, to insure its being strong enough to bear the pressure. It was also necessary, for the perfect action of the valve of a pumping engine, that it should be closed by the time the piston of the pump arrived at the top or the bottom of its stroke; this could only be accomplished by the weight of the valve balancing the maximum velocity of the water put in motion through it, so that it should begin to close as the flow of water diminished, and be quite closed when the motion of the piston ceased; this, he conceived, would be difficult to accomplish with the valve then under consideration.

Mr. Palmer remarked, with reference to these objections, that the opinions given were clearly in opposition to facts deduced from fifteen months' operation of this pump, raising water under a vertical column of 40 feet, during which period, the slip, or loss, of water approached nearer to the calculated result than any pump duty that had come under his observation. In reference to the second objection, it was quite clear the valve-spindle must be of adequate strength, to support the column of water the pump had to lift: he believed that no greater evil (considered in an abstract sense) could result from the use of a large spindle, than an increased friction at its bearings, and a corresponding loss of velocity in the fall of the valve. These evils were, however, neutralized by increasing the eccentricity of the spindle, and thereby enlarging the valve's area above the spindle, which increased area would always be considered, in reference to the altitude

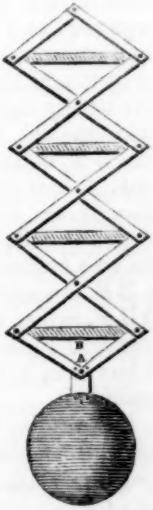
of the column of water above the valve, in order to insure the least loss of water, and at the same time, to avoid the percussive action so detrimental in other pumps. As regarded the third objection, namely, that there would be great difficulty in keeping the disk-valve perfectly tight; he would remark, that in the pump referred to, the minor axis of the piston was not sensibly worn, while the major axis was shortened $\frac{3}{20}$ths of an inch, but still preserving the true elliptic form, and fitting the pump as accurately as when first put into action, although the piston had made upwards of 16,800,000 double strokes, and had traveled over a rubbing surface exceeding, 2,100 miles, during the upward or effective stroke. The wear of the clack-valve at the major axis was less than $\frac{1}{30}$th part of an inch, while at the minor axis it had undergone no change, although the number of beats it had made equalled the number of strokes of the pump. The modifications of the elliptic disk piston and valve into the trapezium form, as proposed by Mr. Galloway, appeared to him to be attended, not only with a considerable increase of cost in the manufacture and the fitting of the trapezium valve, and the working-barrel, but also increasing the amount of rubbing surface, with a corresponding amount of wear and tear, as compared with a pump having the elliptic valve performing the like amount of duty. The two semi-elliptic valves proposed by Mr. Galloway, were ingenious, but they were contrived with the view of remedying an evil that did not really exist in the disk-elliptic piston valve, namely, wear and tear of the minor axis, and leakage at the parts supposed to be worn; nor would the action of the two elliptic leaves, he conceived, be as efficient as the simple elliptic disk piston valve.

Civ. Eng. & Arc. Journ.

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

A Compensating Pendulum.

In the last number of your Journal (August,) there is proposed a method of forming compensating pendulums of a single piece of metal.—Since reading the article, the following modification has occurred to me, which, if found to obviate the defects noticed by Mr. T. E., may be of use to some of your readers. Instead of a single triangle, let the pendulum consist of a single piece of sheet metal, cut as represented in the adjoining figure. Mr. E.'s reasoning is as applicable to the combined triangles, here shown, as to the single one; so that the perpendicular distance A B, (if the sides and diagonal are rightly proportioned to one another,) will remain constant, and the same here as in the single form. Thus, a pendulum may be obtained of any required length without an inconvenient width, and possessing sufficient practical rigidity.



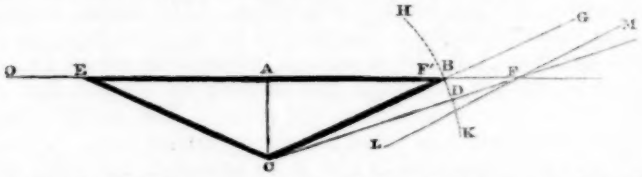
O. K.

Chowan county, N. Carolina, Aug. 20, 1844.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Compensating Pendulum.

In a communication which I sent you yesterday, I offered a modification of the form of a compensating pendulum, proposed in the last number of your Journal, by your correspondent T. E.; but further reflection has shown me that neither the modification, nor the original proposition, is of any use, if applied to pendulums.



The triangle E C B, represents the shape of the proposed pendulum rod. In order that the perpendicular distance A C, may remain the same during all contractions and expansions of the sides of the triangle, the expansions and contractions must act in the directions of A B, and A E. [For the sake of clearness and brevity, we will make use of only half the pendulum, viz., the triangle A B C, (the line A C, of course, being only imaginary, and not in the pendulum.)] Taking for granted that equal degrees of temperature acting on metallic rods of different lengths, the longer the rod the greater will be the amount of expansion and contraction; and since C B, is longer than A B, C B must expand more than A B, and the expansion and contraction must consequently act in the direction of the longer side C B, rather than in that of the shorter side A B, and thus the perpendicular distance A C, must vary. But let us suppose A C, to remain constant and the same during all changes of temperature, and that A B, and C B, have expanded to F; since equal degrees of heat expand longer rods more than shorter ones, and since C B, is longer than A B, D F ought also to be longer than B F.* But let A B C, be a right angled triangle, having its right angle at A; from the centre C, at the distance C B, draw the arc H K; let the side A D, be extended to any point F; join C F, cutting the arc H K, in D; join B D; the side D F, is neither equal to nor greater than the side B F. C B D, being an equilateral triangle, the angles G B D, and F D B, which are complements of the angles C B D, and C D B, are equal; but the angle G B D, contains the two angles G B F, and D B F. Therefore, F B D, which = G B D— G B F, is less than F D B; and the side D F, which subtends the angle D B F, is less than the side B F, which subtends the angle B D F. Hence D F, the increment of the longer side C B, (which is = to C D,) is less than B F, the increment of the shorter side A B, which is hardly possible.

In a similar manner, by taking a point, F', between A and B, we might show that the longer side C B, would, in contracting more than

* In other words, the triangle B D F, ought to be similar and similarly situated to the triangle A C B.

the shorter one A B, lessen the perpendicular distance A C. The same reasoning may, of course, be applied to the remaining half (E C A,) of the pendulum. O. K.

Chowan county, N. C., Aug. 21, 1844.

Storm-Glass.

The storm-glass is a very elegant and economical little "weather-wise," which deserves more attention than it has yet received. It is usually, indeed, to be found at the shops of the philosophical instrument makers and opticians, but its real merits are comparatively little known. This is perhaps owing to its great simplicity and cheapness —few believing that the meteorological indications of an instrument of such unpretending appearance, and which every one may make for himself at so trifling a cost, are at all to be relied upon. For some purposes, however, it is more worthy of dependence than instruments of fifty times its price, and its indications are always accompanied with interest, and often with astonishment, in those who are unacquainted with the principle.

To prepare the instrument, take two drachms of camphor, half a drachm of pure nitrate of potash, (nitre, or saltpetre,) and half a drachm of muriate of ammonia, (sal-ammoniac,) and triturate them together until they are thoroughly pulverized. The operation may be assisted by adding a few drops of alcohol. When well triturated, the mixture is to be dissolved in about two ounces of proof spirits. (good whiskey,) and put into a tall phial, as an *Eau de Cologne* bottle, or into a glass tube of about ten inches in height and three-fourths of an inch diameter, the mouth of which is to be covered with a bit of bladder, or the like, perforated with a pin. The instrument is then complete.

The indications which it gives are of this nature:—If the atmosphere be dry, and the weather promising to be *fine*, all the solid part of the composition which appears in the glass will be closely collected at the bottom, and the liquid above will be quite clear; but on the approach of a change to rain, the solid matter will appear gradually to rise, and small crystaline stars will be observed to float about in the liquid, which, however, will remain otherwise pellucid. On the approach of winds, flocks of the composition, apparently in the form of a leaf, will appear on the surface of the liquid, which, in this case, will seem thick, and in a state of fermentation. These indications often begin to exhibit themselves twenty-four hours before the actual breaking forth of the storm; and after a short experience in observing the changes of appearance of the materials in the glass, not only the magnitude of the coming storm will readily be estimated, but likewise its direction; for the quarter of the compass from which the wind blows will always be indicated by the circumstance of the solid particles lying more closely to the side of the glass opposite to that whence the tempest comes. During the winter, the composition is rendered white by the multitude of small white stars which are con-

stantly floating about in the liquid; this is particularly remarkable during white frost and snow. In summer, on the contrary, when the weather is warm and serene, the liquid is clear, and the solid matter lies at the bottom of the glass.

Some of these indications are as yet unaccounted for; but the leading principle is the solubility of camphor in alcohol, and its insolubility in water, combined with the well known meteorological fact, that the drier the atmosphere, the more aqueous vapor does it take up, and *vice versa*. When, therefore, the weather is warm and dry, a quantity of the water of the menstruum is drawn off in the form of vapor, and, consequently, more of the camphor enters into solution; and, on the contrary, when the air is surcharged with moisture, that moisture begins to be deposited, and the menstruum again will be weakened, and a quantity of the camphor is precipitated from the solution in the form of little crystaline stars. This may easily be proved by making an alcoholic solution of camphor, and adding a few drops of water.

Glasgow Mech. & Eng. Mag.

On Loud Beats of Clocks used in Observatories. By J. S. Eiffe, *Esq.*

This paper gives an explanation of a simple and easily applied method of obtaining very loud beats for the astronomical clock. The mode of constructing the apparatus is as follows:—Two pieces of thin brass are placed at the sides of the frame work of the clock, in length the same as the space between the pillars; in width about two inches, or more, at pleasure; these pieces of brass are placed horizontally at about the same altitude from the base as the axis of the escape-wheel pinion, and at the right angles to it, or nearly so. They should be made of such a size as would insure a sound, distinct, sharp, and short. The little tables can be made to any size. Upon these tables, or plates, two hammers ply, supported by arbors at the same elevation as all the others. The pivots should be made small for easy motion. The hammers are intended to beat upon the middle of each brass table simultaneously with the drop proper of the escape wheel: through the agency of the pendulum, they are lifted alternately by the heels of the anchors of the pallets, assisted by a passing spring similar to that used in the chronometer escapement. It has just been observed, that the arbors which support those little hammers are placed at the same elevation from the base of the brass frame work of the clock as the escape wheel arbor, but at the sides, and as near to the edge as possible. About the centre, or midway between them, are affixed brass collets, about one-eighth of an inch in thickness, and one-fourth of an inch in diameter. Two slender pieces of spring are secured to the collets by screws passing through square holes formed longitudinally, to secure power of adjustment for bringing the arms into proper contact with the anchor of the pallets. The little hammers beat upon the plates, or tables, at one end, and at the other the lifting action takes place, assisted by the passing spring. The strokes upon these

brass tables have a peculiar sharpness of tone, which can be accounted for, in some measure, when it is considered that they are very different from the sounds produced by the teeth of the wheel itself; in the dead-beat escapement the teeth have a sliding motion in the moment of drop, but not impulse, for it is well known that that is subsequent to the sound. By such application it is proposed to obtain sound so loud as to be *distinct in the stormiest night;* but as the constant connexion of such apparatus would neither be desirable as concerns the action of the clock, nor pleasant to the ear as a companion, a mode has been introduced of readily detaching it altogether. By a certain method, which shall be explained, the hammers are raised from the tables at one end, and the arms at the other entirely disengaged from the anchor at the pallet, without inconvenience, or disturbing the action of the clock itself. The apparatus within is immediately, and at pleasure, acted upon through the agency of a bolt, which is placed vertically, immediately over the sixty minutes, or about two inches back, sufficiently long to reach a spring of hard brass, which is about half an inch wide, and which passes transversely over the frame work of the clock, and is fixed securely to the back board of the clock case. Now the mode in which the spring unites its action with the rest of the apparatus is by slight cross-bars, which extend to the extremities of the sides of the frame, so that the ends are immediately over the hammers, with which they are connected by silk threads. Therefore, by pressing down the bolt before named, the hammers are allowed to fall into action, and do their duty simultaneously with the teeth of the wheel upon the pallets. While the little hammers are in action, the teeth of the wheel are no longer heard.

The Astronomer Royal declares by letter, that he has examined the plan, and is enabled to say that it answers completely for its proposed purpose; and that it appears likely to be very useful. Moreover, that the rate of the clock will not necessarily be disturbed during the time of its connexion—though that will greatly depend on certain conditions.—*(Proc. Astron. Soc., Lond.)*

Lond. Athenæum.

An Account of the Erection of the Herschel Obelisk at the Cape of Good Hope, accompanied by the Report of Col. Lewis, and a Plan of the same. By Thomas Maclear, *Esq.*

The following is an abstract:—Sir John Herschel, during his residence at the Cape, was President of the South African Literary and Scientific Institution. When he was about to leave the colony, the members expressed a desire to present him with some token of remembrance; and, at a full meeting, a few days before his departure, a gold medal was presented, with the impress of the Institution on one side, and a suitable inscription on the reverse. The feelings excited on that interesting occasion strongly evinced how much the members regretted the loss of their president, and their admiration of one whose talents place him so far above ordinary men, and whose

private life was a pattern of every domestic virtue. The sum subscribed having exceeded the expense of the medal, another subscription list was opened, with the intention of raising a fund for the purpose of placing a substantial structure on the site of the twenty feet reflector in the garden of Sir John's late residence at Feldhausen. The proposal was accordingly laid before Sir George Napier, who entered warmly into the project, and placed his name at the head of the list annexed to a handsome subscription. In the course of a few days the sum subscribed amounted to 190*l.* At a general meeting, held on the 28th of November, 1838, the erection of the obelisk was finally determined on; and a committee was appointed to carry its erection into effect. A fruitless attempt to procure a granite column at the Cape, of proper workmanship, and within the resources of the committee, led to the adoption of a suggestion, that one of Craigleith stone, from the quarry near Edinburgh, might be obtained without difficulty, and of superior finish. A resolution was accordingly passed by the committee, which, together with a plan of the proposed obelisk, was forwarded to Professors Forbes and Henderson, of Edinburgh, with a request that those gentlemen would kindly undertake the necessary superintendence of the work; a request to which they acceded with alacrity,—and the obelisk, in packing cases, arrived in Table Bay in the month of August, 1841, where it was safely landed, under the guidance of Col. Lewis.

The following is the report of Colonel Lewis on the erection:—"In excavating the foundation, which was of black sand, it was found necessary to go down 4 feet 10 inches, to arrive at the iron stone gravelly bed, the substratum of the country about Feldhausen. The masonry foundation was formed of concrete, built up in courses of 12 or 14 inches, and composed of iron stone, gravel, and lime mortar, well grouted together. On this masonry bed a granite platform 9 feet 6 inches square was laid, and the small column fixed by Sir John Herschel on the site of the 20 feet reflector. This mark was removed for a few days, in order to bring the masonry foundation to a proper height, but the mark was relaid with mathematical correctness by Lieut. Laffau, Royal Engineers. Previously, however, to relaying the Herschel mark, the suggestion of the committee of construction was adopted of placing under it several silver and copper coins, a few inscription medals, and medals of the South African Institution, struck in silver for the occasion; and on the obverse were engraved some notices, statistical and geographical, of the colony; the discoveries of Capt. Ross in the South Polar Regions in 1841, and the operation of remeasuring the arc of the meridian in 1842. These subjects were beautifully executed by Mr. Piazza Smyth, assistant astronomer, and hermetically sealed in glass bottles. Also there were deposited a map of the colony, and engravings of nebulæ, observed at Slough, from 1825 to 1833, by Sir John Herschel, and a plan of Mr. Maclear's triangulation, connecting the site Feldhausen with the Royal Observatory, and the site of La Caille's observatory, in Strand street, Cape Town. The bottle was carefully fixed in a block of teak wood, scooped out on purpose. When the granite platform was brought to

its level, and the Herschel mark refixed and filled in with cement, it was necessary to erect heavy shears of large spars, to place the stones of the obelisk, composed of large blocks of Craigleith stone, some weighing two tons. This was accomplished with some trouble and expense, and the base of the obelisk was laid with the faces corresponding with the four cardinal points. The whole was completed on the 15th of February, 1842, in presence of some of the committee, and several of the subscribers and friends of Sir John Herschel, who attended on the occasion of placing the top stone of the obelisk. The obelisk has the base 6 feet square by 6 feet in height, and the pyramidal part stands 12 feet above the base. On the east face is an opening showing the Herschel mark, designating the site of the 20 feet reflector. The opening will be closed with a bronze plate, containing the inscription of the purpose for which the obelisk is erected." —*Proc. Astron. Soc., Lond.* Ibid.

Energiatype, a new Photographic Process. By Robert Hunt.

While pursuing some investigations, with a view to determine the influence of the solar rays upon precipitation, I have been led to the discovery of a new photographic agent, which can be employed in the preparation of paper with a facility which no other sensitive process possesses. Being desirous of affording all the information I possibly can to those who are anxious to avail themselves of the advantages offered by photography, I solicit a little space in your columns for the purpose of publishing the particulars of this new process. All the photographic processes with which we are at present acquainted, sufficiently sensitive for the fixation of the images of the camera obscura, require the most careful and precise manipulation; consequently, those who are not accustomed to the niceties of experimental pursuits, are frequently annoyed by failures. The following statement will at once show the exceeding simplicity of the new discovery.

Good letter paper is first washed over with the following solution:

A saturated solution of succinic acid,	2 drachms.
Mucilage of gum arabic,	½ "
Water,	1½ "

When the paper is dry, it is washed over once with an argentine solution, consisting of one drachm of nitrate of silver to one ounce of distilled water. The paper is allowed to dry in the dark, and it is fit for use. It can be preserved in a port-folio, and at any time employed in the camera. This paper is a pure white, and it retains its color, which is a great advantage. At present I find it necessary to expose this prepared paper in the camera obscura for periods varying with the quantity of sunshine, from two to eight minutes, although, from some results which I have obtained, I am satisfied that, by a nice adjustment of the proportions of the materials, a much shorter exposure will suffice. When the paper is removed from the camera, no trace of a picture is visible. We have then to mix together one

drachm of a saturated solution of sulphate of iron, and two or three drachms of the mucilage of gum arabic. A wide, flat brush, saturated with this solution, is now swept over the face of the paper rapidly and evenly. In a few seconds the dormant images are seen to develop themselves, and with great rapidity a pleasing negative photographic picture is produced. The iron solution is to be washed off as soon as the best effect appears, this being done with a soft sponge and clean water. The drawing is then soaked for a short time in water, and may be permanently fixed by being washed over with ammonia, or perhaps better with a solution of the hyposulphite of soda, care being taken that the salt is afterwards well washed out of the paper. From the picture thus produced, any number of others, correct in position, and in light and shadow, may be produced, by using the same succinated papers in the ordinary way, from five to ten minutes in sunshine producing the desired effect.

The advantages which this process possesses over every other must be, I think, apparent. The papers are prepared in the most simple manner, and may be kept ready by the tourist until required for use. They require no preparation previously to their being placed in the camera, and they can be preserved until a convenient opportunity offers for bringing out the picture, which is done in the most simple manner, with a material which can be any where procured.

Anxious to give the public the advantage of this process during the beautiful weather of the present season, I have not waited to perfect the manipulatory details which are necessaay for the production of portraits. It is sufficient, however, to say, that experiment has satisfied me of its applicability for this purpose.

Prismatic examination has proved that the rays effecting this chemical change, are those which I have elsewhere shown to be perfectly independent of solar light, or heat. I, therefore, propose to distinguish this process by a name which has a general, rather than a particular, application. Regarding all photographic phenomena as due to the principle *Energia*, I would, nevertheless, wish to distinguish this very interesting process as the *Energiatype*.

I enclose you a few specimens of the results already obtained. The exceeding sensibility of the Energiatype is best shown by an attempt to copy engravings, or leaves, by it. The three specimens I enclose, were produced by an exposnre of considerably less than one second. —*Athenæum.*

In a subsequent number of the "Athenæum," Mr. Hunt has given the following additional directions:—

Experience has suggested to me the advantage of adding to the solution of succinic acid and gum, as previously given, five grains of common salt. This preserves the lights very clear, and, indeed, improves the sensibility of the paper.

When the solution of the sulphate of iron is laid over the paper, it is requisite to keep disturbing it, by rapidly, but lightly, brushing it up; otherwise numerous little black specks form, which destroy the photograph. If, as sometimes happens, the surface of the picture blackens all over, it must not be concluded that the drawing is des-

troyed. The whole of this superficial blackness may be removed by immediately washing with a wet sponge. If the lights become in any way discolored, a little exceedingly diluted hydrochloric (muriatic) acid will restore them to their proper degree of whiteness; but care must be taken that the acid is speedily washed off, or the shadows will suffer.

When, from the shortness of the exposure, the image develops itself slowly, or imperfectly, a slight degree of warmth brings out the picture with rapidity and force. Holding the paper a short distance from the fire is the best mode of operating.

Lond. Reper. Pat. Inven.

Note on a Means of Preserving the Crystals of Salts as permanent objects for Microscopic Investigation. By Robert Warrington, *Esq.**

Having occasion lately to require the crystals of various salts, in a state fitted for examination, by polarized light under the microscope, and as the preparation of these crystals was frequently attended with much trouble and loss of time, it became a point of importance to render the object, when once perfected, permanent, so that the investigation of certain individual crystals could be repeated, and additional observations made at any period. This was rendered the more desirable from the difficulty of obtaining perfect and isolated subjects, and the rapidity with which many of these undergo alteration by exposure to the air. With some few salts this operation was comparatively easy, as the Canada balsam offered an excellent medium for the purpose, but in the greater number of cases I have examined, it proved totally indifferent; and this arises from two causes, the first from the action of the turpentine contained in the balsam rendering the surfaces of the crystals opalescent; the second, from the heat, which it was necessary to apply to make the balsam sufficiently fluid to displace the atmospheric air, fusing the salt in its water of crystalization, or rendering it opake from the loss of water. Olive oil on trial appeared a good medium for all cases, but was objectionable from its fluidity, and from its depositing its stearine in cold weather. Castor oil was then tried, and this I have adopted with great satisfaction.

The method to be adopted in mounting these specimens is as follows:—A warm saturated solution of the salt required is to be prepared, and a drop of it placed upon the glass slider, on which it is intended to be permanently mounted, and allowed to crystalize; when a good group of crystals is obtained, the uncrystalized portion is to be cautiously removed; this is best effected by drawing it gradually away in a small stream along the edge of the slider, having previously broken through that part of the crystaline ring adjacent to the edge; the salt is to be allowed to drain itself quite dry by placing the slider on its end in a vertical position. It should next be examined under the microscope, to ascertain the fitness of the crystals for the

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purpose required, because many salts separate from their solutions in crystals too thin to exhibit any prismatic colors when viewed by polarized light, appearing only of a pearly, or silvery, aspect, while others form in the opposite extreme, and are totally unfit, from their thickness, for investigation. Presuming, however, that the crystals are such as the investigator requires, the next step is to drop on a small quantity of castor oil; that which has been filtered cold must be employed, as otherwise it is liable to the same objection as olive oil, and care must be taken that it covers the whole of the salt, and has displaced all the particles of atmospheric air that may have been adhering to the crystals. This having been done, a small piece of very thin glass is to be carefully placed on the surface of the oil, and any excess which may, by this means, have been pressed out, cautiously removed by bibulous paper from the edges. Two or three coats of a strong varnish of shellac, as ordinary sealing-wax in spirits of wine, or japanners' gold size, are then to be placed round the margin, so as completely to inclose the oil, and the crystals are permanently preserved for observation. It may be perhaps as well to observe, that the one layer of varnish must be allowed to dry for about twenty-four hours before the next is applied, and that during this time the slider must be maintained in a flat position.

Lond., Edin., and Dub. Philos. Mag.

On the Chlorides of Gold.

Great difficulty has hitherto occurred in preparing the chloride of gold, of the yellow and red colors, perfectly soluble in water, and without suffering reduction. The following processes are recommended for this purpose:—

1st. In order to prepare the yellow salt of gold, take *aqua regia* prepared with three parts of hydrochloric acid, one part of nitric acid, and one of distilled water. Then put one part of pure gold into a porcelain capsule, and pour the *aqua regia* upon it; cover the capsule with a plate of glass, and heat it in a salt water bath, the heat being continued till red vapors cease; the cover is then to be removed, and if the gold is not entirely dissolved, some *aqua regia* is to be added to it; the capsule being again covered, the heat is to be continued till vapor ceases to appear; the glass plate must then be removed, and replaced by folds of blotting paper, the heat being continued in the bath until a glass rod being immersed in the capsule, it becomes covered, on removing it, with yellow, solid chloride of gold.

The capsule is then to be removed from the salt water bath, and the chloride of gold soon crystalizes in small prysmatic crystals, of a fine yellow color, with an orange tint. The chloride, thus obtained, is perfectly soluble in water without reduction; it is successfully employed in Daguerréotype and other operations.

The *red* chloride of gold (terchloride) is prepared in the same manner, except that the *aqua regia* employed is prepared with two parts of hydrochloric, and one part of nitric, acid. The operation is com-

menced by acting upon gold with excess of *aqua regia* on a sand bath, the salt water bath not being used until the gold is entirely dissolved; the remainder of the operation is conducted in the same manner as that for the yellow chloride.—*Journ. de Ph. et de Ch., Mai*, 1844. Ibid.

Improvement in the Daguerréotype Process.

A communication was made by M. Daguerré to the Paris Academy of Science, relative to some improvements in the Daguerréotype process, chiefly for the purpose of taking portraits, the ordinary mode of preparing the plates not being found sufficient to enable the operator to obtain good impressions. The improvement made by M. Daguerré, requires a rather complicated process, but it is a very regular one, and has one decided advantage, for the artist is now enabled to have a good stock of plates on hand, as the new preparation will remain for a very long time in a perfectly fit state for use. The new substances of which M. Daguerré makes use, are an aqueous solution of bi-chlorure of mercury, an aqueous solution of cyanure of mercury, oil of white petroleum, acidulated with nitric acid, and a solution of platina and chlorure of gold. The process is as follows:—the plate is polished with sublimate and tripoli, and then red oxide of iron, until a fine black be obtained; it is now placed in the horizontal plane, and the solution of cyanure, previously made hot by the lamp, is poured over it. The mercury deposits itself, and forms a white coating. The plate is allowed to cool a little, and after having poured off the liquid, it is dried by the usual process of cotton and rouge. The white coating deposited by the mercury is now to be polished.—With a ball *(tampon)* of cotton saturated with oil and rouge, this coating is rubbed just sufficiently for the plate to be of a fine black. This being done, the plate is again placed upon the horizontal plane, and the solution of gold and platina is poured over it. The plate is to be heated, and then left to cool, and the liquid having been poured off, the plate is dried by means of cotton and rouge. In doing this, care must be had that the plate be merely dried, not polished. On this metallic varnish, M. Daguerré has succeeded in taking some very fine impressions of the human figure, which were exhibited.

London Athenæum.

Lunar Occultations.

Lunar Occultations visible in Philadelphia, computed by Mrs. Charlotte S. Downes, from the Elements published with the Occultation list for the United States Almanac.

The Immersions and Emersions are for Philadelphia, mean astronomical time. Im. for Immersion, Em. for Emersion. These abbreviations in *Italics* refer to those Immersions and Emersions which take place on the Moon's dark limb. N. App. for Near Approach.

The angles are for *inverted image*, or as seen in an astronomical telescope, and reckoned from the Moon's North point and from its Vertex around through East, South, West, to North and Vertex again. For direct vision add 180°.

OCTOBER, 1844.

Day.	H'r.	Min.	Star's name.	Mag.	From North.	From Vertex.
1	17	16	Im. ι Tauri,	4.5	90°	57°
	18	14	*Em.*		271	224
7	16	59	Im. c Lextantis,	6	170	218
	17	34	*Em.*		237	281
17	8	38	*Im.* 2246 Bailey,	7	65	29
	9	43	Em.		256	211
22	6	26	*Im.* 16 Piscium,	6	54	95
	7	44	Em.		245	273
22	13	50	*Im.* m Piscium,	6	70	22
	14	53	Em.		245	195
26	6	47	Im. π Arietis,	5	118	170
	7	29	*Em.*		198	251
30	17	1	Im. υ Geminor,	5	130	93
	18	19	Em.		259	208
			NOVEMBER.			
3	14	5	Im. Bessel,	8	110°	145°
	15	18	*Em.*		293	325
4	14	9	Im. Lalande,	6	131	182
	15	7	*Em.*		273	322
4	16	52	Im. Bessel,	8	107	146
	18	7	*Em.*		311	335
5	13	11	Im. Bessel,	8	139	189
	13	57	*Em.*		262	312
5	13	11	Im. Bessel,	7	139	189
	13	57	*Em.*		262	312
6	15	11	Im. Bessel,	8	171	221
	15	41	*Em.*		234	284
13	5	36	*Im.* Lalande,	8	9	316
	6	8	Em.		341	283
13	6	46	*Im.* Lalande,	7.8	115	77
	7	32	Em.		209	165
14	8	39	*Im.* Lalande,	8	97	52
	9	31	Em.		220	171
15	5	58	*Im.* Bessel,	7	53	40
	7	15	Em.		252	224
16	5	24	*Im.* c^1 Capricorni,	6	119	127
	6	5	Em.		192	189
18	8	32	*Im.* κ^1 Piscium,	5.6	109	90
	9	24	Em.		188	156
29	8	41	N.App.29 Cancri,	6		
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